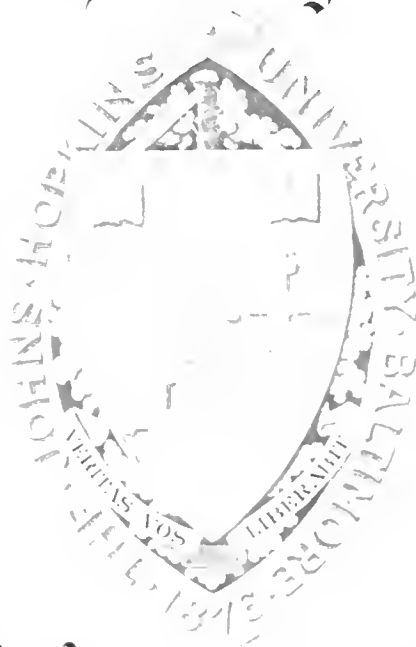


THE NEW YORK PUBLIC LIBRARY
ASTOR LENOX TILDEN FOUNDATION
3 1151 02679 5785

Library



Johns Hopkins University



REPORT MADE BY THE JAMES H. HARRIS FOUNDATION, INC.,
OF THE UNIVERSITY OF CALIFORNIA, AND THE JAMES H. HARRIS FOUNDATION, INC.,
ON THE JAMES H. HARRIS FOUNDATION, INC.

DISCUSSION.

SUBMITTED TO THE BOARD OF UNIVERSITY STUDIES
OF THE JAMES HARRIS FOUNDATION, INC.,
IN COMPLIANCE WITH THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY.

BY

WILLIAM H. HARRIS.

ALBANY, N. Y.

1911.

C O N T E N T S

Page

| | | |
|-----|--|--|
| I. | Wave-lengths of Arc and Spark Lines..... | |
| | Introduction..... | |
| | Arc Spectra | |
| | Spark Spectra | |
| | Measurements | |
| | 1. Methods | |
| | 2. Symbols | |
| | 3. Tables | |
| | (a) Titanium..... | |
| | (b) Manganese | |
| | (c) Vanadium | |
| II. | Effects of Capacity and Self-Induction | |
| | Introduction | |
| | Apparatus and Methods | |
| | General Effects | |
| | Shift of Lines | |
| | Conclusion | |

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY
UNITED STATES NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
BUREAU OF CHEMISTRY
WASHINGTON, D. C.

Introduction.

The importance of accurate determination of the weight of a substance is course fully recognized, and this is particularly true in the case of the determination of the weight of a substance by the use of a balance. The accuracy of such work is controlled by the accuracy of the balance used. The accuracy of the balance is determined by the accuracy of the weights used. The accuracy of the weights is determined by the accuracy of the standards of weight.

As the first and standards have been accepted, the accuracy of the balance is determined by the accuracy of the standards. The accuracy of the standards is determined by the accuracy of the standards. The accuracy of the standards is determined by the accuracy of the standards. The accuracy of the standards is determined by the accuracy of the standards.

Also See.

Accuracy of the balance. - The accuracy of the balance is determined by the accuracy of the standards. The accuracy of the standards is determined by the accuracy of the standards. The accuracy of the standards is determined by the accuracy of the standards. The accuracy of the standards is determined by the accuracy of the standards.

the upper plate position. The arc-stud was rigidly fixed in position at a distance of 14 cm. from the slit and 1 mm. from the slit and the grating. The light was focussed on the slit by a movable quartz lens supported by a screw which was rigidly fixed in line with the slit and grating.

The iron arc for comparison was a 3-ampere arc such as has been described by Pfund.* The terminals were placed in the same stand used for the arc of the other substance.

By means of a shutter with a horizontal slot of the same width as the thickness of the shutter and on a horizontal axis, the spectrum of the substance was taken at the centre of the plate and the comparison spectrum of the other substance.

As mechanical shifts were found on test plates several methods of correctly determining the true relative positions of the lines of the two spectra were used. By taking plates of an iron lens, a positive pole of the substance and a negative pole of iron, the true relative positions of the lines could be determined. When the impurities common to the two arcs were sufficiently strong, the mechanical shift was at once apparent. Another, and more satisfactory, method was to load the positive

* Astrophys. Jour., 17, 340.

carbon, iron, iron oxide, iron filings, and carbon dust, in the ratio of 1:1:1:1. In all cases all these materials were used. The last scheme makes it unnecessary to use the iron arc for comparison, besides vibration-mechanical studies. To test whether the iron lines obtained by using the mixture suffered any displacement because of the presence of the other substances, exposures were made giving the arc of the mixture on the centre of the plate and the standard iron arc on either side. The coincidence of the ends of the lines showed that no displacement had occurred.

Spark Gap and Apparatus.

Apparatus and Method. The spark used was produced by a 110-volt alternating current of 25 ampere with a frequency of 60 cycles per sec. by means of a transformer the voltage was "stepped up" to 1000, which was then "stepped up" to about 20,000 by another transformer. This potential was sufficient to produce a spark of about 1 cm. length. The spark terminals were of conical shaped metal, which was reshaped for each exposure in order to keep the spark steady.

In parallel with the secondary circuit the condenser was consisting of copper foil and glass plates provided by moisture-free transformer oil and with a capacity of .03 micro-farad.

The spark used was .001 in. in length, and its image on the slit was .0017 in. The capacity that gave the best sparking results when no self-induction was introduced was .016 micro farad, which amount remained constant throughout the work on the wavelengths of the spark lines.

The comparison arc consisted of ionized carbon poles as described above. The terminals of arc and spark were fixed in exactly similar sliding clamp-rods, having but one degree of freedom, which were inserted in the same sockets of the fixed arc-stand. Wires on the rods insured the same positions of arc and spark relative to the slit. Moreover, as the focussing lens remained in position after one exposure, any difference in the positions of the two sources was at once detected by the displacement of the image on the slit. Although care was taken to have the positions the same, tests, which will be discussed later, proved that great caution was necessary.

To avoid mechanical shifts as far as possible, the shutter of the camera box was detached and fastened to clamp-stands resting on the floor, and the plate-holder was secured. As in the case of the arc spectra the shift could be detected by comparing the lines in the two spectra due to impurities. But to avoid any possibility of error due to a mechanical shift the method of half-exposure was used, i.e. the plate was exposed half-time to the spark, full time to the arc, and then half-time again to the spark.

The exposures were made in the second order spectrum, if possible, and the width of the slit is approximately equal to 1 mm. on the plate. Seaton's Gilt Edge No. 2, Grainger's Isocromatic, and Wratten & Wainwright's Panchromatic plates were used. As the Gilt Edge plates are not as sensitive as the K100, the light screens necessary are placed between the plate and the slit.

MEASUREMENTS.

In calculating the wavelengths, the standard iron arc lines as determined by Hulsén and Faury* were used. The measurements were made with the dividing-circle constructed by Rowland especially for this work and by the method described by Wapenars.** After reducing the scale of the scale to Angstrom units by multiplying by a factor slightly different from unity, corrections were made from a calibration curve for each plate which was drawn with the standard wavelengths as a abscissa and the differences between these wavelengths and the readings of the scale as ordinates. The corrections for each line could then be read from the curve.

As a check on the work the plates were taken so as to overlap.

In estimating the intensities, the iron arc line $\lambda 404.66$ was used as the standard, and its intensity is marked 10, the same being done for the other lines by Kayser.

* Compt. Rend. No. 21, 1895; Journal de Physique VII, 1900.

** Astro. Phys. Journ. 1, 190, 1917.

Examples.

1 indicates that the line is ill-defined or undefined; 2 that it is defined on the less refracted side; 3 that it is defined on the more refracted side; and 4 that it is also reversed.

Alphabet.

| Wavelengths | Arc | Intensities Spectrum. | Wavelengths | Arc | Intensities Spectrum. |
|-------------|-----|--------------------------|-------------|-----|--------------------------|
| 3974.620 | 4 | 3 | 3075.190 | 0 | |
| 43.593 | 5 | 4 | 38.638 | 0 | |
| 1000.000 | 7 | 7 | 30.121 | | |
| 3.727 | 6 | 5 | 34.032 | | |
| 1.175 | 3 | 10 ^r | 33.026 | 10 | |
| 29.003 | 4 | 10 | 39.394 | | |
| 43.546 | 3 | 1 | 30.127 | | |
| 43.547 | 3 | 2 | 37.178 | | |
| 46.671 | 7 | 7 | 3101.511 | | |
| 18.766 | 4 | 3 | 4.800 | | |
| 5.731 | 1 | 4 | 5.010 | | |
| 58.085 | 8 | 7 | 7.025 | | |
| 9.731 | 5 | 7 | 6.800 | | |
| 60.451 | 6 | 1 | 7.453 | | |
| 62.414 | 3 | 2 | 9.576 | | |
| 16.197 | 8 | 7 | 10.074 | | |
| 16.357 | 6 | 1 | 11.278 | | |
| 16.516 | 5 | 4 | 12.050 | | |
| 11.29 | 5 | 3 | 12.478 | | |
| 12.099 | 6 | 7 | 14.092 | | |
| 7.971 | 10 | | 17.154 | | |

Station.

| Wavelengths | Intensities. | Wavelength | Intensities. |
|-------------|--------------|------------|--------------|
| Ang | Spark | Ang | Spark |
| 3117.462 | | 3142.090 | |
| 31.722 | | 31.760 | |
| 39.745 | | 39.857 | |
| 41.595 | - | 41.519 | |
| 43.071 | - | 40.513 | |
| 43.764 | | 42.721 | |
| 48.640 | + | 49.254 | |
| 49.009 | - | 43.970 | |
| 50.740 | | 46.454 | |
| 55.926 | | 50.848 | |
| 61.613 | | 52.008 | |
| 61.773 | | 55.707 | |
| 64.750 | | 57.538 | |
| 66.516 | | 59.906 | |
| 67.254 | | 6201.782 | |
| 68.030 | | 6.524 | |
| 72.239 | | 6.420 | |
| 83.501 | | 6.415 | |
| 84.124 | | 4.866 | |
| 85.854 | | 5.645 | |
| 87.390 | | 6.545 | |

| $\frac{1}{2} \pi$ A | $\frac{1}{2} \pi$ S | $\frac{1}{2} \pi$ A | $\frac{1}{2} \pi$ S |
|------------------------|------------------------|------------------------|------------------------|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 |
| 0.001 | 0 | 0 | 0 |
| 0.002 | 0 | 0.00140 | 0 |
| 0.003 | 0 | 0 | 0 |
| 0.004 | 0 | 0.00280 | 0 |
| 0.005 | 0 | 0.00420 | 0 |
| 0.006 | 0 | 0 | 0 |
| 0.007 | 0 | 0.00560 | 0 |
| 0.008 | 0 | 0.00700 | 0 |
| 0.009 | 0 | 0 | 0 |
| 0.010 | 0 | 0.00840 | 0 |
| 0.011 | 0 | 0 | 0 |
| 0.012 | 0 | 0.00980 | 0 |
| 0.013 | 0 | 0.01120 | 0 |
| 0.014 | 0 | 0 | 0 |
| 0.015 | 0 | 0.01260 | 0 |
| 0.016 | 0 | 0.01400 | 0 |
| 0.017 | 0 | 0 | 0 |
| 0.018 | 0 | 0.01540 | 0 |
| 0.019 | 0 | 0.01680 | 0 |
| 0.020 | 0 | 0 | 0 |
| 0.021 | 0 | 0.01820 | 0 |
| 0.022 | 0 | 0.01960 | 0 |
| 0.023 | 0 | 0 | 0 |
| 0.024 | 0 | 0.02100 | 0 |
| 0.025 | 0 | 0.02240 | 0 |
| 0.026 | 0 | 0 | 0 |
| 0.027 | 0 | 0.02380 | 0 |
| 0.028 | 0 | 0.02520 | 0 |
| 0.029 | 0 | 0 | 0 |
| 0.030 | 0 | 0.02660 | 0 |
| 0.031 | 0 | 0.02800 | 0 |
| 0.032 | 0 | 0 | 0 |
| 0.033 | 0 | 0.02940 | 0 |
| 0.034 | 0 | 0.03080 | 0 |
| 0.035 | 0 | 0 | 0 |
| 0.036 | 0 | 0.03220 | 0 |
| 0.037 | 0 | 0.03360 | 0 |
| 0.038 | 0 | 0 | 0 |
| 0.039 | 0 | 0.03500 | 0 |
| 0.040 | 0 | 0.03640 | 0 |
| 0.041 | 0 | 0 | 0 |
| 0.042 | 0 | 0.03780 | 0 |
| 0.043 | 0 | 0.03920 | 0 |
| 0.044 | 0 | 0 | 0 |
| 0.045 | 0 | 0.04060 | 0 |
| 0.046 | 0 | 0.04200 | 0 |
| 0.047 | 0 | 0 | 0 |
| 0.048 | 0 | 0.04340 | 0 |
| 0.049 | 0 | 0.04480 | 0 |
| 0.050 | 0 | 0 | 0 |
| 0.051 | 0 | 0.04620 | 0 |
| 0.052 | 0 | 0.04760 | 0 |
| 0.053 | 0 | 0 | 0 |
| 0.054 | 0 | 0.04900 | 0 |
| 0.055 | 0 | 0.05040 | 0 |
| 0.056 | 0 | 0 | 0 |
| 0.057 | 0 | 0.05180 | 0 |
| 0.058 | 0 | 0.05320 | 0 |
| 0.059 | 0 | 0 | 0 |
| 0.060 | 0 | 0.05460 | 0 |
| 0.061 | 0 | 0.05600 | 0 |
| 0.062 | 0 | 0 | 0 |
| 0.063 | 0 | 0.05740 | 0 |
| 0.064 | 0 | 0.05880 | 0 |
| 0.065 | 0 | 0 | 0 |
| 0.066 | 0 | 0.06020 | 0 |
| 0.067 | 0 | 0.06160 | 0 |
| 0.068 | 0 | 0 | 0 |
| 0.069 | 0 | 0.06300 | 0 |
| 0.070 | 0 | 0.06440 | 0 |
| 0.071 | 0 | 0 | 0 |
| 0.072 | 0 | 0.06580 | 0 |
| 0.073 | 0 | 0.06720 | 0 |
| 0.074 | 0 | 0 | 0 |
| 0.075 | 0 | 0.06860 | 0 |
| 0.076 | 0 | 0.07000 | 0 |
| 0.077 | 0 | 0 | 0 |
| 0.078 | 0 | 0.07140 | 0 |
| 0.079 | 0 | 0.07280 | 0 |
| 0.080 | 0 | 0 | 0 |
| 0.081 | 0 | 0.07420 | 0 |
| 0.082 | 0 | 0.07560 | 0 |
| 0.083 | 0 | 0 | 0 |
| 0.084 | 0 | 0.07700 | 0 |
| 0.085 | 0 | 0.07840 | 0 |
| 0.086 | 0 | 0 | 0 |
| 0.087 | 0 | 0.07980 | 0 |
| 0.088 | 0 | 0.08120 | 0 |
| 0.089 | 0 | 0 | 0 |
| 0.090 | 0 | 0.08260 | 0 |
| 0.091 | 0 | 0.08400 | 0 |
| 0.092 | 0 | 0 | 0 |
| 0.093 | 0 | 0.08540 | 0 |
| 0.094 | 0 | 0.08680 | 0 |
| 0.095 | 0 | 0 | 0 |
| 0.096 | 0 | 0.08820 | 0 |
| 0.097 | 0 | 0.08960 | 0 |
| 0.098 | 0 | 0 | 0 |
| 0.099 | 0 | 0.09100 | 0 |
| 0.100 | 0 | 0.09240 | 0 |

| X = 7.1 | | | X = 7.2 | | |
|---------|-------|-------|---------|-------|-------|
| A | | | B | | |
| 0.000 | | | 0.000 | | |
| 0.001 | | | 0.001 | | |
| 0.002 | | | 0.002 | | |
| 0.003 | | | 0.003 | | |
| 0.004 | | | 0.004 | | |
| 0.005 | 0 | | 0.005 | | |
| 0.006 | | | 0.006 | | |
| 0.007 | 0 | | 0.007 | | |
| 0.008 | | | 0.008 | | |
| 0.009 | | | 0.009 | | |
| 0.010 | | | 0.010 | | |
| 0.011 | 0.000 | 0.000 | 0.011 | 0.000 | 0.000 |
| 0.012 | | | 0.012 | 0.000 | 0.000 |
| 0.013 | | | 0.013 | 0.000 | 0.000 |
| 0.014 | | | 0.014 | 0.000 | 0.000 |
| 0.015 | | | 0.015 | 0.000 | 0.000 |
| 0.016 | | | 0.016 | 0.000 | 0.000 |
| 0.017 | | | 0.017 | 0.000 | 0.000 |
| 0.018 | | | 0.018 | 0.000 | 0.000 |
| 0.019 | | | 0.019 | 0.000 | 0.000 |
| 0.020 | | | 0.020 | 0.000 | 0.000 |
| 0.021 | | | 0.021 | 0.000 | 0.000 |
| 0.022 | | | 0.022 | 0.000 | 0.000 |
| 0.023 | | | 0.023 | 0.000 | 0.000 |
| 0.024 | | | 0.024 | 0.000 | 0.000 |
| 0.025 | | | 0.025 | 0.000 | 0.000 |
| 0.026 | | | 0.026 | 0.000 | 0.000 |
| 0.027 | | | 0.027 | 0.000 | 0.000 |
| 0.028 | | | 0.028 | 0.000 | 0.000 |
| 0.029 | | | 0.029 | 0.000 | 0.000 |
| 0.030 | | | 0.030 | 0.000 | 0.000 |

| Latitude | Longitude, Arc | | Height | Longitude, Arc | |
|----------|----------------|----|--------|----------------|----|
| 40° 15' | 1 | 1 | 10,000 | 1 | 1 |
| 40° 15' | 2 | 2 | 10,000 | 2 | 2 |
| 40° 15' | 3 | 3 | 10,000 | 3 | 3 |
| 40° 15' | 4 | 4 | 10,000 | 4 | 4 |
| 40° 15' | 5 | 5 | 10,000 | 5 | 5 |
| 40° 15' | 6 | 6 | 10,000 | 6 | 6 |
| 40° 15' | 7 | 7 | 10,000 | 7 | 7 |
| 40° 15' | 8 | 8 | 10,000 | 8 | 8 |
| 40° 15' | 9 | 9 | 10,000 | 9 | 9 |
| 40° 15' | 10 | 10 | 10,000 | 10 | 10 |
| 40° 15' | 11 | 11 | 10,000 | 11 | 11 |
| 40° 15' | 12 | 12 | 10,000 | 12 | 12 |
| 40° 15' | 13 | 13 | 10,000 | 13 | 13 |
| 40° 15' | 14 | 14 | 10,000 | 14 | 14 |
| 40° 15' | 15 | 15 | 10,000 | 15 | 15 |
| 40° 15' | 16 | 16 | 10,000 | 16 | 16 |
| 40° 15' | 17 | 17 | 10,000 | 17 | 17 |
| 40° 15' | 18 | 18 | 10,000 | 18 | 18 |
| 40° 15' | 19 | 19 | 10,000 | 19 | 19 |
| 40° 15' | 20 | 20 | 10,000 | 20 | 20 |
| 40° 15' | 21 | 21 | 10,000 | 21 | 21 |
| 40° 15' | 22 | 22 | 10,000 | 22 | 22 |
| 40° 15' | 23 | 23 | 10,000 | 23 | 23 |
| 40° 15' | 24 | 24 | 10,000 | 24 | 24 |
| 40° 15' | 25 | 25 | 10,000 | 25 | 25 |
| 40° 15' | 26 | 26 | 10,000 | 26 | 26 |
| 40° 15' | 27 | 27 | 10,000 | 27 | 27 |
| 40° 15' | 28 | 28 | 10,000 | 28 | 28 |
| 40° 15' | 29 | 29 | 10,000 | 29 | 29 |
| 40° 15' | 30 | 30 | 10,000 | 30 | 30 |
| 40° 15' | 31 | 31 | 10,000 | 31 | 31 |
| 40° 15' | 32 | 32 | 10,000 | 32 | 32 |
| 40° 15' | 33 | 33 | 10,000 | 33 | 33 |
| 40° 15' | 34 | 34 | 10,000 | 34 | 34 |
| 40° 15' | 35 | 35 | 10,000 | 35 | 35 |
| 40° 15' | 36 | 36 | 10,000 | 36 | 36 |
| 40° 15' | 37 | 37 | 10,000 | 37 | 37 |
| 40° 15' | 38 | 38 | 10,000 | 38 | 38 |
| 40° 15' | 39 | 39 | 10,000 | 39 | 39 |
| 40° 15' | 40 | 40 | 10,000 | 40 | 40 |
| 40° 15' | 41 | 41 | 10,000 | 41 | 41 |
| 40° 15' | 42 | 42 | 10,000 | 42 | 42 |
| 40° 15' | 43 | 43 | 10,000 | 43 | 43 |
| 40° 15' | 44 | 44 | 10,000 | 44 | 44 |
| 40° 15' | 45 | 45 | 10,000 | 45 | 45 |
| 40° 15' | 46 | 46 | 10,000 | 46 | 46 |
| 40° 15' | 47 | 47 | 10,000 | 47 | 47 |
| 40° 15' | 48 | 48 | 10,000 | 48 | 48 |
| 40° 15' | 49 | 49 | 10,000 | 49 | 49 |
| 40° 15' | 50 | 50 | 10,000 | 50 | 50 |
| 40° 15' | 51 | 51 | 10,000 | 51 | 51 |
| 40° 15' | 52 | 52 | 10,000 | 52 | 52 |
| 40° 15' | 53 | 53 | 10,000 | 53 | 53 |
| 40° 15' | 54 | 54 | 10,000 | 54 | 54 |
| 40° 15' | 55 | 55 | 10,000 | 55 | 55 |
| 40° 15' | 56 | 56 | 10,000 | 56 | 56 |
| 40° 15' | 57 | 57 | 10,000 | 57 | 57 |
| 40° 15' | 58 | 58 | 10,000 | 58 | 58 |
| 40° 15' | 59 | 59 | 10,000 | 59 | 59 |
| 40° 15' | 60 | 60 | 10,000 | 60 | 60 |

34-11-11

| Latitude | Latitude | Latitude | Latitude | Latitude |
|----------|----------|----------|----------|----------|
| 36.34.1 | 36 | 36 | 36.34.1 | 36 |
| 36.34.7 | 36 | 36 | 36.34.7 | 36 |
| 36.34.8 | 36 | 36 | 36.34.8 | 36 |
| 36.34.9 | 36 | 36 | 36.34.9 | 36 |
| 36.35.0 | 36 | 36 | 36.35.0 | 36 |
| 36.35.1 | 36 | 36 | 36.35.1 | 36 |
| 36.35.2 | 36 | 36 | 36.35.2 | 36 |
| 36.35.3 | 36 | 36 | 36.35.3 | 36 |
| 36.35.4 | 36 | 36 | 36.35.4 | 36 |
| 36.35.5 | 36 | 36 | 36.35.5 | 36 |
| 36.35.6 | 36 | 36 | 36.35.6 | 36 |
| 36.35.7 | 36 | 36 | 36.35.7 | 36 |
| 36.35.8 | 36 | 36 | 36.35.8 | 36 |
| 36.35.9 | 36 | 36 | 36.35.9 | 36 |
| 36.36.0 | 36 | 36 | 36.36.0 | 36 |
| 36.36.1 | 36 | 36 | 36.36.1 | 36 |
| 36.36.2 | 36 | 36 | 36.36.2 | 36 |
| 36.36.3 | 36 | 36 | 36.36.3 | 36 |
| 36.36.4 | 36 | 36 | 36.36.4 | 36 |
| 36.36.5 | 36 | 36 | 36.36.5 | 36 |
| 36.36.6 | 36 | 36 | 36.36.6 | 36 |
| 36.36.7 | 36 | 36 | 36.36.7 | 36 |
| 36.36.8 | 36 | 36 | 36.36.8 | 36 |
| 36.36.9 | 36 | 36 | 36.36.9 | 36 |
| 36.37.0 | 36 | 36 | 36.37.0 | 36 |
| 36.37.1 | 36 | 36 | 36.37.1 | 36 |
| 36.37.2 | 36 | 36 | 36.37.2 | 36 |
| 36.37.3 | 36 | 36 | 36.37.3 | 36 |
| 36.37.4 | 36 | 36 | 36.37.4 | 36 |
| 36.37.5 | 36 | 36 | 36.37.5 | 36 |
| 36.37.6 | 36 | 36 | 36.37.6 | 36 |
| 36.37.7 | 36 | 36 | 36.37.7 | 36 |
| 36.37.8 | 36 | 36 | 36.37.8 | 36 |
| 36.37.9 | 36 | 36 | 36.37.9 | 36 |
| 36.38.0 | 36 | 36 | 36.38.0 | 36 |
| 36.38.1 | 36 | 36 | 36.38.1 | 36 |
| 36.38.2 | 36 | 36 | 36.38.2 | 36 |
| 36.38.3 | 36 | 36 | 36.38.3 | 36 |
| 36.38.4 | 36 | 36 | 36.38.4 | 36 |
| 36.38.5 | 36 | 36 | 36.38.5 | 36 |
| 36.38.6 | 36 | 36 | 36.38.6 | 36 |
| 36.38.7 | 36 | 36 | 36.38.7 | 36 |
| 36.38.8 | 36 | 36 | 36.38.8 | 36 |
| 36.38.9 | 36 | 36 | 36.38.9 | 36 |
| 36.39.0 | 36 | 36 | 36.39.0 | 36 |
| 36.39.1 | 36 | 36 | 36.39.1 | 36 |
| 36.39.2 | 36 | 36 | 36.39.2 | 36 |
| 36.39.3 | 36 | 36 | 36.39.3 | 36 |
| 36.39.4 | 36 | 36 | 36.39.4 | 36 |
| 36.39.5 | 36 | 36 | 36.39.5 | 36 |
| 36.39.6 | 36 | 36 | 36.39.6 | 36 |
| 36.39.7 | 36 | 36 | 36.39.7 | 36 |
| 36.39.8 | 36 | 36 | 36.39.8 | 36 |
| 36.39.9 | 36 | 36 | 36.39.9 | 36 |

Table 1

| Year | Age | Sex | Year | Age | Sex |
|------|-----|-----|------|-----|-----|
| 1979 | 1 | 1 | 1979 | 1 | 1 |
| 1980 | 1 | 1 | 1980 | 1 | 1 |
| 1981 | 1 | 1 | 1981 | 1 | 1 |
| 1982 | 1 | 1 | 1982 | 1 | 1 |
| 1983 | 1 | 1 | 1983 | 1 | 1 |
| 1984 | 1 | 1 | 1984 | 1 | 1 |
| 1985 | 1 | 1 | 1985 | 1 | 1 |
| 1986 | 1 | 1 | 1986 | 1 | 1 |
| 1987 | 1 | 1 | 1987 | 1 | 1 |
| 1988 | 1 | 1 | 1988 | 1 | 1 |
| 1989 | 1 | 1 | 1989 | 1 | 1 |
| 1990 | 1 | 1 | 1990 | 1 | 1 |
| 1991 | 1 | 1 | 1991 | 1 | 1 |
| 1992 | 1 | 1 | 1992 | 1 | 1 |
| 1993 | 1 | 1 | 1993 | 1 | 1 |
| 1994 | 1 | 1 | 1994 | 1 | 1 |
| 1995 | 1 | 1 | 1995 | 1 | 1 |
| 1996 | 1 | 1 | 1996 | 1 | 1 |
| 1997 | 1 | 1 | 1997 | 1 | 1 |
| 1998 | 1 | 1 | 1998 | 1 | 1 |
| 1999 | 1 | 1 | 1999 | 1 | 1 |
| 2000 | 1 | 1 | 2000 | 1 | 1 |
| 2001 | 1 | 1 | 2001 | 1 | 1 |
| 2002 | 1 | 1 | 2002 | 1 | 1 |
| 2003 | 1 | 1 | 2003 | 1 | 1 |
| 2004 | 1 | 1 | 2004 | 1 | 1 |
| 2005 | 1 | 1 | 2005 | 1 | 1 |
| 2006 | 1 | 1 | 2006 | 1 | 1 |
| 2007 | 1 | 1 | 2007 | 1 | 1 |
| 2008 | 1 | 1 | 2008 | 1 | 1 |
| 2009 | 1 | 1 | 2009 | 1 | 1 |
| 2010 | 1 | 1 | 2010 | 1 | 1 |
| 2011 | 1 | 1 | 2011 | 1 | 1 |
| 2012 | 1 | 1 | 2012 | 1 | 1 |
| 2013 | 1 | 1 | 2013 | 1 | 1 |
| 2014 | 1 | 1 | 2014 | 1 | 1 |
| 2015 | 1 | 1 | 2015 | 1 | 1 |
| 2016 | 1 | 1 | 2016 | 1 | 1 |
| 2017 | 1 | 1 | 2017 | 1 | 1 |
| 2018 | 1 | 1 | 2018 | 1 | 1 |
| 2019 | 1 | 1 | 2019 | 1 | 1 |
| 2020 | 1 | 1 | 2020 | 1 | 1 |

| 1912, 1 | 2 | 3 | 4 | 5 | 6 |
|---------|----|----|---|----------|---|
| 12.10 | | 10 | | | 1 |
| 14.20 | 1 | 1 | | 10 | 1 |
| 15.20 | 1 | 1 | | | 1 |
| 16.75 | 1 | | | 1 | 1 |
| 18.15 | 1 | 1 | | 10 | |
| 21.42 | 1 | | | 10 | 1 |
| 24.15 | 1 | 1 | | 1000.425 | 1 |
| 25.10 | 1 | | | 1.075 | 1 |
| 27.10 | 1 | 1 | | 1.135 | 1 |
| 28.15 | 1 | 1 | | 1.135 | 1 |
| 30.17 | 1 | 1 | | 1.135 | 1 |
| 34.20 | 1 | 1 | | 1.135 | 1 |
| 47.754 | | 1 | | 1.135 | 1 |
| 14.10 | 10 | 1 | | 1.135 | 1 |
| 15.10 | 10 | 1 | | 1.135 | 1 |
| 16.10 | 10 | | | 1.135 | 1 |
| 17.11 | | 1 | | 1.135 | 1 |
| 18.17 | 1 | 1 | | 1.135 | 1 |
| 21.75 | | | | 1.135 | 1 |
| 22.10 | 1 | 1 | | 1.135 | 1 |

Table 1

| Sample No. | Age | Sex | Weight (kg) | Length (cm) | Sex | Weight (kg) | Length (cm) |
|------------|-----|-----|-------------|-------------|-----|-------------|-------------|
| 10,113 | 4 | 1 | 10,113 | 1 | 1 | 10,113 | 1 |
| 10,114 | 5 | 1 | 10,114 | 1 | 1 | 10,114 | 1 |
| 10,115 | 6 | 1 | 10,115 | 1 | 1 | 10,115 | 1 |
| 10,116 | 4 | 1 | 10,116 | 1 | 1 | 10,116 | 1 |
| 10,117 | 1 | 1 | 10,117 | 1 | 1 | 10,117 | 1 |
| 10,118 | 6 | 1 | 10,118 | 1 | 1 | 10,118 | 1 |
| 10,119 | 1 | 1 | 10,119 | 1 | 1 | 10,119 | 1 |
| 10,120 | 2 | 1 | 10,120 | 1 | 1 | 10,120 | 1 |
| 10,121 | 2 | 1 | 10,121 | 1 | 1 | 10,121 | 1 |
| 10,122 | 2 | 1 | 10,122 | 1 | 1 | 10,122 | 1 |
| 10,123 | 2 | 1 | 10,123 | 1 | 1 | 10,123 | 1 |
| 10,124 | 2 | 1 | 10,124 | 1 | 1 | 10,124 | 1 |
| 10,125 | 2 | 1 | 10,125 | 1 | 1 | 10,125 | 1 |
| 10,126 | 2 | 1 | 10,126 | 1 | 1 | 10,126 | 1 |
| 10,127 | 2 | 1 | 10,127 | 1 | 1 | 10,127 | 1 |
| 10,128 | 2 | 1 | 10,128 | 1 | 1 | 10,128 | 1 |
| 10,129 | 2 | 1 | 10,129 | 1 | 1 | 10,129 | 1 |
| 10,130 | 2 | 1 | 10,130 | 1 | 1 | 10,130 | 1 |
| 10,131 | 2 | 1 | 10,131 | 1 | 1 | 10,131 | 1 |
| 10,132 | 2 | 1 | 10,132 | 1 | 1 | 10,132 | 1 |
| 10,133 | 2 | 1 | 10,133 | 1 | 1 | 10,133 | 1 |
| 10,134 | 2 | 1 | 10,134 | 1 | 1 | 10,134 | 1 |
| 10,135 | 2 | 1 | 10,135 | 1 | 1 | 10,135 | 1 |
| 10,136 | 2 | 1 | 10,136 | 1 | 1 | 10,136 | 1 |
| 10,137 | 2 | 1 | 10,137 | 1 | 1 | 10,137 | 1 |
| 10,138 | 2 | 1 | 10,138 | 1 | 1 | 10,138 | 1 |
| 10,139 | 2 | 1 | 10,139 | 1 | 1 | 10,139 | 1 |
| 10,140 | 2 | 1 | 10,140 | 1 | 1 | 10,140 | 1 |
| 10,141 | 2 | 1 | 10,141 | 1 | 1 | 10,141 | 1 |
| 10,142 | 2 | 1 | 10,142 | 1 | 1 | 10,142 | 1 |
| 10,143 | 2 | 1 | 10,143 | 1 | 1 | 10,143 | 1 |
| 10,144 | 2 | 1 | 10,144 | 1 | 1 | 10,144 | 1 |
| 10,145 | 2 | 1 | 10,145 | 1 | 1 | 10,145 | 1 |
| 10,146 | 2 | 1 | 10,146 | 1 | 1 | 10,146 | 1 |
| 10,147 | 2 | 1 | 10,147 | 1 | 1 | 10,147 | 1 |
| 10,148 | 2 | 1 | 10,148 | 1 | 1 | 10,148 | 1 |
| 10,149 | 2 | 1 | 10,149 | 1 | 1 | 10,149 | 1 |
| 10,150 | 2 | 1 | 10,150 | 1 | 1 | 10,150 | 1 |
| 10,151 | 2 | 1 | 10,151 | 1 | 1 | 10,151 | 1 |
| 10,152 | 2 | 1 | 10,152 | 1 | 1 | 10,152 | 1 |
| 10,153 | 2 | 1 | 10,153 | 1 | 1 | 10,153 | 1 |
| 10,154 | 2 | 1 | 10,154 | 1 | 1 | 10,154 | 1 |
| 10,155 | 2 | 1 | 10,155 | 1 | 1 | 10,155 | 1 |
| 10,156 | 2 | 1 | 10,156 | 1 | 1 | 10,156 | 1 |
| 10,157 | 2 | 1 | 10,157 | 1 | 1 | 10,157 | 1 |
| 10,158 | 2 | 1 | 10,158 | 1 | 1 | 10,158 | 1 |
| 10,159 | 2 | 1 | 10,159 | 1 | 1 | 10,159 | 1 |
| 10,160 | 2 | 1 | 10,160 | 1 | 1 | 10,160 | 1 |
| 10,161 | 2 | 1 | 10,161 | 1 | 1 | 10,161 | 1 |
| 10,162 | 2 | 1 | 10,162 | 1 | 1 | 10,162 | 1 |
| 10,163 | 2 | 1 | 10,163 | 1 | 1 | 10,163 | 1 |
| 10,164 | 2 | 1 | 10,164 | 1 | 1 | 10,164 | 1 |
| 10,165 | 2 | 1 | 10,165 | 1 | 1 | 10,165 | 1 |
| 10,166 | 2 | 1 | 10,166 | 1 | 1 | 10,166 | 1 |
| 10,167 | 2 | 1 | 10,167 | 1 | 1 | 10,167 | 1 |
| 10,168 | 2 | 1 | 10,168 | 1 | 1 | 10,168 | 1 |
| 10,169 | 2 | 1 | 10,169 | 1 | 1 | 10,169 | 1 |
| 10,170 | 2 | 1 | 10,170 | 1 | 1 | 10,170 | 1 |
| 10,171 | 2 | 1 | 10,171 | 1 | 1 | 10,171 | 1 |
| 10,172 | 2 | 1 | 10,172 | 1 | 1 | 10,172 | 1 |
| 10,173 | 2 | 1 | 10,173 | 1 | 1 | 10,173 | 1 |
| 10,174 | 2 | 1 | 10,174 | 1 | 1 | 10,174 | 1 |
| 10,175 | 2 | 1 | 10,175 | 1 | 1 | 10,175 | 1 |
| 10,176 | 2 | 1 | 10,176 | 1 | 1 | 10,176 | 1 |
| 10,177 | 2 | 1 | 10,177 | 1 | 1 | 10,177 | 1 |
| 10,178 | 2 | 1 | 10,178 | 1 | 1 | 10,178 | 1 |
| 10,179 | 2 | 1 | 10,179 | 1 | 1 | 10,179 | 1 |
| 10,180 | 2 | 1 | 10,180 | 1 | 1 | 10,180 | 1 |
| 10,181 | 2 | 1 | 10,181 | 1 | 1 | 10,181 | 1 |
| 10,182 | 2 | 1 | 10,182 | 1 | 1 | 10,182 | 1 |
| 10,183 | 2 | 1 | 10,183 | 1 | 1 | 10,183 | 1 |
| 10,184 | 2 | 1 | 10,184 | 1 | 1 | 10,184 | 1 |
| 10,185 | 2 | 1 | 10,185 | 1 | 1 | 10,185 | 1 |
| 10,186 | 2 | 1 | 10,186 | 1 | 1 | 10,186 | 1 |
| 10,187 | 2 | 1 | 10,187 | 1 | 1 | 10,187 | 1 |
| 10,188 | 2 | 1 | 10,188 | 1 | 1 | 10,188 | 1 |
| 10,189 | 2 | 1 | 10,189 | 1 | 1 | 10,189 | 1 |
| 10,190 | 2 | 1 | 10,190 | 1 | 1 | 10,190 | 1 |
| 10,191 | 2 | 1 | 10,191 | 1 | 1 | 10,191 | 1 |
| 10,192 | 2 | 1 | 10,192 | 1 | 1 | 10,192 | 1 |
| 10,193 | 2 | 1 | 10,193 | 1 | 1 | 10,193 | 1 |
| 10,194 | 2 | 1 | 10,194 | 1 | 1 | 10,194 | 1 |
| 10,195 | 2 | 1 | 10,195 | 1 | 1 | 10,195 | 1 |
| 10,196 | 2 | 1 | 10,196 | 1 | 1 | 10,196 | 1 |
| 10,197 | 2 | 1 | 10,197 | 1 | 1 | 10,197 | 1 |
| 10,198 | 2 | 1 | 10,198 | 1 | 1 | 10,198 | 1 |
| 10,199 | 2 | 1 | 10,199 | 1 | 1 | 10,199 | 1 |
| 10,200 | 2 | 1 | 10,200 | 1 | 1 | 10,200 | 1 |

Table 1

| Station | Area | Depth | Volume | Weight | Concentration |
|---------|------|-------|---------|--------|---------------|
| 107.11 | 1 | 0 | 4218.00 | | |
| 107.12 | 2 | 0 | 24.784 | | |
| 107.13 | 3 | 0 | 27.041 | | |
| 107.14 | 4 | 0 | 27.0 | | |
| 107.15 | 5 | 0 | 27.310 | | |
| 107.16 | 6 | 0 | 27.111 | | |
| 107.17 | 7 | 0 | 51.004 | | |
| 107.18 | 8 | 0 | 21.750 | | |
| 107.19 | 9 | 10 | 50.039 | | |
| 107.20 | 10 | 0 | 27.01 | | |
| 107.21 | 11 | 0 | 27.11 | | |
| 107.22 | 12 | 0 | 27.02 | | |
| 107.23 | 13 | 0 | 27.121 | | |
| 107.24 | 14 | 0 | 27.0 | | |
| 107.25 | 15 | 0 | 70.140 | | |
| 107.26 | 16 | 0 | 27.11 | | |
| 107.27 | 17 | 0 | 27.00 | | |
| 107.28 | 18 | 0 | 27.00 | | |
| 107.29 | 19 | 0 | 70.113 | | |
| 107.30 | 20 | 0 | 70.001 | | |
| 107.31 | 21 | 0 | 70.135 | | |

| I - Series, | I - Series, | | I - Series, | I - Series, | |
|-------------|-------------|---|-------------|-------------|----|
| | A | B | | A | B |
| .1 | | | 12,000 | 4 | 5 |
| 0.000 | | | 11,000 | 1 | 6 |
| 0.000 | | | 11,000 | 4 | 7 |
| 0.000 | | | 11,000 | 4 | 10 |
| .3. | | | 11,000 | 3 | 10 |
| .00 | | | 11,000 | 1 | 1 |
| .020 | | | 10,000 | 2 | 1 |
| .1 | | | 11,000 | 1 | 3 |
| .2-1 | | | 11,000 | 4 | |
| .000 | | | 11,000 | 3 | 4 |
| .100 | | | 11,000 | 3 | |
| 0.000 | | | 11,000 | 3 | 3 |
| 0.000 | 4 | 4 | 10,000 | 3 | 4 |
| 0.000 | 4 | 3 | 11,000 | 4 | 4 |
| .000 | 4 | 4 | 11,000 | 3 | 3 |
| .000 | 5 | 4 | 11,000 | 4 | 3 |
| .000 | 3 | 4 | 11,000 | 4 | 3 |
| .000 | 4 | 4 | 11,000 | 3 | 3 |
| .000 | 5 | 4 | 11,000 | 3 | 4 |
| 00,000 | 4 | 5 | 11,000 | 4 | 4 |

Appendix

| Item | Age | Intelligible Score | Percentage | Age | Intelligible Score |
|---------|-----|--------------------|------------|-----|--------------------|
| 100.000 | 0 | 1 | 100.000 | 0 | 1 |
| 100.000 | 1 | 1 | 100.000 | 1 | 1 |
| 100.000 | 2 | 2 | 100.000 | 2 | 1 |
| 100.000 | 3 | 3 | 100.000 | 3 | 1 |
| 100.000 | 4 | 4 | 100.000 | 4 | 1 |
| 100.000 | 5 | 5 | 100.000 | 5 | 1 |
| 100.000 | 6 | 6 | 100.000 | 6 | 1 |
| 100.000 | 7 | 7 | 100.000 | 7 | 1 |
| 100.000 | 8 | 8 | 100.000 | 8 | 1 |
| 100.000 | 9 | 9 | 100.000 | 9 | 1 |
| 100.000 | 10 | 10 | 100.000 | 10 | 1 |
| 100.000 | 11 | 11 | 100.000 | 11 | 1 |
| 100.000 | 12 | 12 | 100.000 | 12 | 1 |
| 100.000 | 13 | 13 | 100.000 | 13 | 1 |
| 100.000 | 14 | 14 | 100.000 | 14 | 1 |
| 100.000 | 15 | 15 | 100.000 | 15 | 1 |
| 100.000 | 16 | 16 | 100.000 | 16 | 1 |
| 100.000 | 17 | 17 | 100.000 | 17 | 1 |
| 100.000 | 18 | 18 | 100.000 | 18 | 1 |
| 100.000 | 19 | 19 | 100.000 | 19 | 1 |
| 100.000 | 20 | 20 | 100.000 | 20 | 1 |
| 100.000 | 21 | 21 | 100.000 | 21 | 1 |
| 100.000 | 22 | 22 | 100.000 | 22 | 1 |
| 100.000 | 23 | 23 | 100.000 | 23 | 1 |
| 100.000 | 24 | 24 | 100.000 | 24 | 1 |
| 100.000 | 25 | 25 | 100.000 | 25 | 1 |
| 100.000 | 26 | 26 | 100.000 | 26 | 1 |
| 100.000 | 27 | 27 | 100.000 | 27 | 1 |
| 100.000 | 28 | 28 | 100.000 | 28 | 1 |
| 100.000 | 29 | 29 | 100.000 | 29 | 1 |
| 100.000 | 30 | 30 | 100.000 | 30 | 1 |
| 100.000 | 31 | 31 | 100.000 | 31 | 1 |
| 100.000 | 32 | 32 | 100.000 | 32 | 1 |
| 100.000 | 33 | 33 | 100.000 | 33 | 1 |
| 100.000 | 34 | 34 | 100.000 | 34 | 1 |
| 100.000 | 35 | 35 | 100.000 | 35 | 1 |
| 100.000 | 36 | 36 | 100.000 | 36 | 1 |
| 100.000 | 37 | 37 | 100.000 | 37 | 1 |
| 100.000 | 38 | 38 | 100.000 | 38 | 1 |
| 100.000 | 39 | 39 | 100.000 | 39 | 1 |
| 100.000 | 40 | 40 | 100.000 | 40 | 1 |
| 100.000 | 41 | 41 | 100.000 | 41 | 1 |
| 100.000 | 42 | 42 | 100.000 | 42 | 1 |
| 100.000 | 43 | 43 | 100.000 | 43 | 1 |
| 100.000 | 44 | 44 | 100.000 | 44 | 1 |
| 100.000 | 45 | 45 | 100.000 | 45 | 1 |
| 100.000 | 46 | 46 | 100.000 | 46 | 1 |
| 100.000 | 47 | 47 | 100.000 | 47 | 1 |
| 100.000 | 48 | 48 | 100.000 | 48 | 1 |
| 100.000 | 49 | 49 | 100.000 | 49 | 1 |
| 100.000 | 50 | 50 | 100.000 | 50 | 1 |
| 100.000 | 51 | 51 | 100.000 | 51 | 1 |
| 100.000 | 52 | 52 | 100.000 | 52 | 1 |
| 100.000 | 53 | 53 | 100.000 | 53 | 1 |
| 100.000 | 54 | 54 | 100.000 | 54 | 1 |
| 100.000 | 55 | 55 | 100.000 | 55 | 1 |
| 100.000 | 56 | 56 | 100.000 | 56 | 1 |
| 100.000 | 57 | 57 | 100.000 | 57 | 1 |
| 100.000 | 58 | 58 | 100.000 | 58 | 1 |
| 100.000 | 59 | 59 | 100.000 | 59 | 1 |
| 100.000 | 60 | 60 | 100.000 | 60 | 1 |
| 100.000 | 61 | 61 | 100.000 | 61 | 1 |
| 100.000 | 62 | 62 | 100.000 | 62 | 1 |
| 100.000 | 63 | 63 | 100.000 | 63 | 1 |
| 100.000 | 64 | 64 | 100.000 | 64 | 1 |
| 100.000 | 65 | 65 | 100.000 | 65 | 1 |
| 100.000 | 66 | 66 | 100.000 | 66 | 1 |
| 100.000 | 67 | 67 | 100.000 | 67 | 1 |
| 100.000 | 68 | 68 | 100.000 | 68 | 1 |
| 100.000 | 69 | 69 | 100.000 | 69 | 1 |
| 100.000 | 70 | 70 | 100.000 | 70 | 1 |
| 100.000 | 71 | 71 | 100.000 | 71 | 1 |
| 100.000 | 72 | 72 | 100.000 | 72 | 1 |
| 100.000 | 73 | 73 | 100.000 | 73 | 1 |
| 100.000 | 74 | 74 | 100.000 | 74 | 1 |
| 100.000 | 75 | 75 | 100.000 | 75 | 1 |
| 100.000 | 76 | 76 | 100.000 | 76 | 1 |
| 100.000 | 77 | 77 | 100.000 | 77 | 1 |
| 100.000 | 78 | 78 | 100.000 | 78 | 1 |
| 100.000 | 79 | 79 | 100.000 | 79 | 1 |
| 100.000 | 80 | 80 | 100.000 | 80 | 1 |
| 100.000 | 81 | 81 | 100.000 | 81 | 1 |
| 100.000 | 82 | 82 | 100.000 | 82 | 1 |
| 100.000 | 83 | 83 | 100.000 | 83 | 1 |
| 100.000 | 84 | 84 | 100.000 | 84 | 1 |
| 100.000 | 85 | 85 | 100.000 | 85 | 1 |
| 100.000 | 86 | 86 | 100.000 | 86 | 1 |
| 100.000 | 87 | 87 | 100.000 | 87 | 1 |
| 100.000 | 88 | 88 | 100.000 | 88 | 1 |
| 100.000 | 89 | 89 | 100.000 | 89 | 1 |
| 100.000 | 90 | 90 | 100.000 | 90 | 1 |
| 100.000 | 91 | 91 | 100.000 | 91 | 1 |
| 100.000 | 92 | 92 | 100.000 | 92 | 1 |
| 100.000 | 93 | 93 | 100.000 | 93 | 1 |
| 100.000 | 94 | 94 | 100.000 | 94 | 1 |
| 100.000 | 95 | 95 | 100.000 | 95 | 1 |
| 100.000 | 96 | 96 | 100.000 | 96 | 1 |
| 100.000 | 97 | 97 | 100.000 | 97 | 1 |
| 100.000 | 98 | 98 | 100.000 | 98 | 1 |
| 100.000 | 99 | 99 | 100.000 | 99 | 1 |
| 100.000 | 100 | 100 | 100.000 | 100 | 1 |

Table 1

| Year | Age | Sex | Weight (kg) | Length (cm) | Wing (cm) | Tail (cm) |
|------|-----|-----|-------------|-------------|-----------|-----------|
| 1961 | 3 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 4 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 5 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 6 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 7 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 8 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 9 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 10 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 11 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 12 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 13 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 14 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 15 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 16 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 17 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 18 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 19 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 20 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 21 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 22 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 23 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 24 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 25 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 26 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 27 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 28 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 29 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 30 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 31 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 32 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 33 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 34 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 35 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 36 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 37 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 38 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 39 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 40 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 41 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 42 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 43 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 44 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 45 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 46 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 47 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 48 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 49 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 50 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 51 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 52 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 53 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 54 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 55 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 56 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 57 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 58 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 59 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 60 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 61 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 62 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 63 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 64 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 65 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 66 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 67 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 68 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 69 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 70 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 71 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 72 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 73 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 74 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 75 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 76 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 77 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 78 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 79 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 80 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 81 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 82 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 83 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 84 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 85 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 86 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 87 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 88 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 89 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 90 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 91 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 92 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 93 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 94 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 95 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 96 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 97 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 98 | F | 3 | 71.1 | 10.5 | 11.5 |
| 1961 | 99 | M | 4 | 71.1 | 10.5 | 11.5 |
| 1961 | 100 | F | 3 | 71.1 | 10.5 | 11.5 |

| Год | Число | Число | Число | Число | Число |
|------|-------|-------|-------|-------|-------|
| 1910 | 1 | | 10,00 | 0 | |
| 1911 | 1 | 3 | 10,00 | 1 | |
| 1912 | 1 | 1 | 10,00 | 1 | |
| 1913 | 1 | 7 | 10,00 | 1 | 1 |
| 1914 | 1 | 1 | 10,00 | 1 | 10 |
| 1915 | 4 | 10 | 10,00 | 1 | 1 |
| 1916 | 1 | | 10,00 | 1 | 1 |
| 1917 | 4 | 1 | 10,00 | 1 | 1 |
| 1918 | 1 | 1 | 10,00 | 1 | 1 |
| 1919 | 1 | 1 | 10,00 | 1 | 1 |
| 1920 | 1 | 1 | 10,00 | 1 | 1 |
| 1921 | 1 | 1 | 10,00 | 1 | 1 |
| 1922 | 1 | 1 | 10,00 | 1 | 1 |
| 1923 | 1 | 1 | 10,00 | 1 | 1 |
| 1924 | 1 | 1 | 10,00 | 1 | 1 |
| 1925 | 1 | 1 | 10,00 | 1 | 1 |
| 1926 | 1 | 1 | 10,00 | 1 | 1 |
| 1927 | 1 | 1 | 10,00 | 1 | 1 |
| 1928 | 1 | 1 | 10,00 | 1 | 1 |
| 1929 | 1 | 1 | 10,00 | 1 | 1 |
| 1930 | 1 | 1 | 10,00 | 1 | 1 |
| 1931 | 1 | 1 | 10,00 | 1 | 1 |
| 1932 | 1 | 1 | 10,00 | 1 | 1 |
| 1933 | 1 | 1 | 10,00 | 1 | 1 |
| 1934 | 1 | 1 | 10,00 | 1 | 1 |
| 1935 | 1 | 1 | 10,00 | 1 | 1 |
| 1936 | 1 | 1 | 10,00 | 1 | 1 |
| 1937 | 1 | 1 | 10,00 | 1 | 1 |
| 1938 | 1 | 1 | 10,00 | 1 | 1 |
| 1939 | 1 | 1 | 10,00 | 1 | 1 |
| 1940 | 1 | 1 | 10,00 | 1 | 1 |
| 1941 | 1 | 1 | 10,00 | 1 | 1 |
| 1942 | 1 | 1 | 10,00 | 1 | 1 |
| 1943 | 1 | 1 | 10,00 | 1 | 1 |
| 1944 | 1 | 1 | 10,00 | 1 | 1 |
| 1945 | 1 | 1 | 10,00 | 1 | 1 |
| 1946 | 1 | 1 | 10,00 | 1 | 1 |
| 1947 | 1 | 1 | 10,00 | 1 | 1 |
| 1948 | 1 | 1 | 10,00 | 1 | 1 |
| 1949 | 1 | 1 | 10,00 | 1 | 1 |
| 1950 | 1 | 1 | 10,00 | 1 | 1 |
| 1951 | 1 | 1 | 10,00 | 1 | 1 |
| 1952 | 1 | 1 | 10,00 | 1 | 1 |
| 1953 | 1 | 1 | 10,00 | 1 | 1 |
| 1954 | 1 | 1 | 10,00 | 1 | 1 |
| 1955 | 1 | 1 | 10,00 | 1 | 1 |
| 1956 | 1 | 1 | 10,00 | 1 | 1 |
| 1957 | 1 | 1 | 10,00 | 1 | 1 |
| 1958 | 1 | 1 | 10,00 | 1 | 1 |
| 1959 | 1 | 1 | 10,00 | 1 | 1 |
| 1960 | 1 | 1 | 10,00 | 1 | 1 |
| 1961 | 1 | 1 | 10,00 | 1 | 1 |
| 1962 | 1 | 1 | 10,00 | 1 | 1 |
| 1963 | 1 | 1 | 10,00 | 1 | 1 |
| 1964 | 1 | 1 | 10,00 | 1 | 1 |
| 1965 | 1 | 1 | 10,00 | 1 | 1 |
| 1966 | 1 | 1 | 10,00 | 1 | 1 |
| 1967 | 1 | 1 | 10,00 | 1 | 1 |
| 1968 | 1 | 1 | 10,00 | 1 | 1 |
| 1969 | 1 | 1 | 10,00 | 1 | 1 |
| 1970 | 1 | 1 | 10,00 | 1 | 1 |
| 1971 | 1 | 1 | 10,00 | 1 | 1 |
| 1972 | 1 | 1 | 10,00 | 1 | 1 |
| 1973 | 1 | 1 | 10,00 | 1 | 1 |
| 1974 | 1 | 1 | 10,00 | 1 | 1 |
| 1975 | 1 | 1 | 10,00 | 1 | 1 |
| 1976 | 1 | 1 | 10,00 | 1 | 1 |
| 1977 | 1 | 1 | 10,00 | 1 | 1 |
| 1978 | 1 | 1 | 10,00 | 1 | 1 |
| 1979 | 1 | 1 | 10,00 | 1 | 1 |
| 1980 | 1 | 1 | 10,00 | 1 | 1 |
| 1981 | 1 | 1 | 10,00 | 1 | 1 |
| 1982 | 1 | 1 | 10,00 | 1 | 1 |
| 1983 | 1 | 1 | 10,00 | 1 | 1 |
| 1984 | 1 | 1 | 10,00 | 1 | 1 |
| 1985 | 1 | 1 | 10,00 | 1 | 1 |
| 1986 | 1 | 1 | 10,00 | 1 | 1 |
| 1987 | 1 | 1 | 10,00 | 1 | 1 |
| 1988 | 1 | 1 | 10,00 | 1 | 1 |
| 1989 | 1 | 1 | 10,00 | 1 | 1 |
| 1990 | 1 | 1 | 10,00 | 1 | 1 |
| 1991 | 1 | 1 | 10,00 | 1 | 1 |
| 1992 | 1 | 1 | 10,00 | 1 | 1 |
| 1993 | 1 | 1 | 10,00 | 1 | 1 |
| 1994 | 1 | 1 | 10,00 | 1 | 1 |
| 1995 | 1 | 1 | 10,00 | 1 | 1 |
| 1996 | 1 | 1 | 10,00 | 1 | 1 |
| 1997 | 1 | 1 | 10,00 | 1 | 1 |
| 1998 | 1 | 1 | 10,00 | 1 | 1 |
| 1999 | 1 | 1 | 10,00 | 1 | 1 |
| 2000 | 1 | 1 | 10,00 | 1 | 1 |
| 2001 | 1 | 1 | 10,00 | 1 | 1 |
| 2002 | 1 | 1 | 10,00 | 1 | 1 |
| 2003 | 1 | 1 | 10,00 | 1 | 1 |
| 2004 | 1 | 1 | 10,00 | 1 | 1 |
| 2005 | 1 | 1 | 10,00 | 1 | 1 |
| 2006 | 1 | 1 | 10,00 | 1 | 1 |
| 2007 | 1 | 1 | 10,00 | 1 | 1 |
| 2008 | 1 | 1 | 10,00 | 1 | 1 |
| 2009 | 1 | 1 | 10,00 | 1 | 1 |
| 2010 | 1 | 1 | 10,00 | 1 | 1 |
| 2011 | 1 | 1 | 10,00 | 1 | 1 |
| 2012 | 1 | 1 | 10,00 | 1 | 1 |
| 2013 | 1 | 1 | 10,00 | 1 | 1 |
| 2014 | 1 | 1 | 10,00 | 1 | 1 |
| 2015 | 1 | 1 | 10,00 | 1 | 1 |
| 2016 | 1 | 1 | 10,00 | 1 | 1 |
| 2017 | 1 | 1 | 10,00 | 1 | 1 |
| 2018 | 1 | 1 | 10,00 | 1 | 1 |
| 2019 | 1 | 1 | 10,00 | 1 | 1 |
| 2020 | 1 | 1 | 10,00 | 1 | 1 |
| 2021 | 1 | 1 | 10,00 | 1 | 1 |
| 2022 | 1 | 1 | 10,00 | 1 | 1 |
| 2023 | 1 | 1 | 10,00 | 1 | 1 |
| 2024 | 1 | 1 | 10,00 | 1 | 1 |
| 2025 | 1 | 1 | 10,00 | 1 | 1 |
| 2026 | 1 | 1 | 10,00 | 1 | 1 |
| 2027 | 1 | 1 | 10,00 | 1 | 1 |
| 2028 | 1 | 1 | 10,00 | 1 | 1 |
| 2029 | 1 | 1 | 10,00 | 1 | 1 |
| 2030 | 1 | 1 | 10,00 | 1 | 1 |
| 2031 | 1 | 1 | 10,00 | 1 | 1 |
| 2032 | 1 | 1 | 10,00 | 1 | 1 |
| 2033 | 1 | 1 | 10,00 | 1 | 1 |
| 2034 | 1 | 1 | 10,00 | 1 | 1 |
| 2035 | 1 | 1 | 10,00 | 1 | 1 |
| 2036 | 1 | 1 | 10,00 | 1 | 1 |
| 2037 | 1 | 1 | 10,00 | 1 | 1 |
| 2038 | 1 | 1 | 10,00 | 1 | 1 |
| 2039 | 1 | 1 | 10,00 | 1 | 1 |
| 2040 | 1 | 1 | 10,00 | 1 | 1 |
| 2041 | 1 | 1 | 10,00 | 1 | 1 |
| 2042 | 1 | 1 | 10,00 | 1 | 1 |
| 2043 | 1 | 1 | 10,00 | 1 | 1 |
| 2044 | 1 | 1 | 10,00 | 1 | 1 |
| 2045 | 1 | 1 | 10,00 | 1 | 1 |
| 2046 | 1 | 1 | 10,00 | 1 | 1 |
| 2047 | 1 | 1 | 10,00 | 1 | 1 |
| 2048 | 1 | 1 | 10,00 | 1 | 1 |
| 2049 | 1 | 1 | 10,00 | 1 | 1 |
| 2050 | 1 | 1 | 10,00 | 1 | 1 |
| 2051 | 1 | 1 | 10,00 | 1 | 1 |
| 2052 | 1 | 1 | 10,00 | 1 | 1 |
| 2053 | 1 | 1 | 10,00 | 1 | 1 |
| 2054 | 1 | 1 | 10,00 | 1 | 1 |
| 2055 | 1 | 1 | 10,00 | 1 | 1 |
| 2056 | 1 | 1 | 10,00 | 1 | 1 |
| 2057 | 1 | 1 | 10,00 | 1 | 1 |
| 2058 | 1 | 1 | 10,00 | 1 | 1 |
| 2059 | 1 | 1 | 10,00 | 1 | 1 |
| 2060 | 1 | 1 | 10,00 | 1 | 1 |
| 2061 | 1 | 1 | 10,00 | 1 | 1 |
| 2062 | 1 | 1 | 10,00 | 1 | 1 |
| 2063 | 1 | 1 | 10,00 | 1 | 1 |
| 2064 | 1 | 1 | 10,00 | 1 | 1 |
| 2065 | 1 | 1 | 10,00 | 1 | 1 |
| 2066 | 1 | 1 | 10,00 | 1 | 1 |
| 2067 | 1 | 1 | 10,00 | 1 | 1 |
| 2068 | 1 | 1 | 10,00 | 1 | 1 |
| 2069 | 1 | 1 | 10,00 | 1 | 1 |
| 2070 | 1 | 1 | 10,00 | 1 | 1 |
| 2071 | 1 | 1 | 10,00 | 1 | 1 |
| 2072 | 1 | 1 | 10,00 | 1 | 1 |
| 2073 | 1 | 1 | 10,00 | 1 | 1 |
| 2074 | 1 | 1 | 10,00 | 1 | 1 |
| 2075 | 1 | 1 | 10,00 | 1 | 1 |
| 2076 | 1 | 1 | 10,00 | 1 | 1 |
| 2077 | 1 | 1 | 10,00 | 1 | 1 |
| 2078 | 1 | 1 | 10,00 | 1 | 1 |
| 2079 | 1 | 1 | 10,00 | 1 | 1 |
| 2080 | 1 | 1 | 10,00 | 1 | 1 |
| 2081 | 1 | 1 | 10,00 | 1 | 1 |
| 2082 | 1 | 1 | 10,00 | 1 | 1 |
| 2083 | 1 | 1 | 10,00 | 1 | 1 |
| 2084 | 1 | 1 | 10,00 | 1 | 1 |
| 2085 | 1 | 1 | 10,00 | 1 | 1 |
| 2086 | 1 | 1 | 10,00 | 1 | 1 |
| 2087 | 1 | 1 | 10,00 | 1 | 1 |
| 2088 | 1 | 1 | 10,00 | 1 | 1 |
| 2089 | 1 | 1 | 10,00 | 1 | 1 |
| 2090 | 1 | 1 | 10,00 | 1 | 1 |
| 2091 | 1 | 1 | 10,00 | 1 | 1 |
| 2092 | 1 | 1 | 10,00 | 1 | 1 |
| 2093 | 1 | 1 | 10,00 | 1 | 1 |
| 2094 | 1 | 1 | 10,00 | 1 | 1 |
| 2095 | 1 | 1 | 10,00 | 1 | 1 |
| 2096 | 1 | 1 | 10,00 | 1 | 1 |
| 2097 | 1 | 1 | 10,00 | 1 | 1 |
| 2098 | 1 | 1 | 10,00 | 1 | 1 |
| 2099 | 1 | 1 | 10,00 | 1 | 1 |
| 2100 | 1 | 1 | 10,00 | 1 | 1 |

Table 4

| Year | Age | Age in years | Age in months | Age in days | Age in hours |
|------|-----|--------------|---------------|-------------|--------------|
| 1950 | 1 | 1 | 1 | 1 | 1 |
| 1951 | 2 | 2 | 2 | 2 | 2 |
| 1952 | 3 | 3 | 3 | 3 | 3 |
| 1953 | 4 | 4 | 4 | 4 | 4 |
| 1954 | 5 | 5 | 5 | 5 | 5 |
| 1955 | 6 | 6 | 6 | 6 | 6 |
| 1956 | 7 | 7 | 7 | 7 | 7 |
| 1957 | 8 | 8 | 8 | 8 | 8 |
| 1958 | 9 | 9 | 9 | 9 | 9 |
| 1959 | 10 | 10 | 10 | 10 | 10 |
| 1960 | 11 | 11 | 11 | 11 | 11 |
| 1961 | 12 | 12 | 12 | 12 | 12 |
| 1962 | 13 | 13 | 13 | 13 | 13 |
| 1963 | 14 | 14 | 14 | 14 | 14 |
| 1964 | 15 | 15 | 15 | 15 | 15 |
| 1965 | 16 | 16 | 16 | 16 | 16 |
| 1966 | 17 | 17 | 17 | 17 | 17 |
| 1967 | 18 | 18 | 18 | 18 | 18 |
| 1968 | 19 | 19 | 19 | 19 | 19 |
| 1969 | 20 | 20 | 20 | 20 | 20 |
| 1970 | 21 | 21 | 21 | 21 | 21 |
| 1971 | 22 | 22 | 22 | 22 | 22 |
| 1972 | 23 | 23 | 23 | 23 | 23 |
| 1973 | 24 | 24 | 24 | 24 | 24 |
| 1974 | 25 | 25 | 25 | 25 | 25 |
| 1975 | 26 | 26 | 26 | 26 | 26 |
| 1976 | 27 | 27 | 27 | 27 | 27 |
| 1977 | 28 | 28 | 28 | 28 | 28 |
| 1978 | 29 | 29 | 29 | 29 | 29 |
| 1979 | 30 | 30 | 30 | 30 | 30 |
| 1980 | 31 | 31 | 31 | 31 | 31 |
| 1981 | 32 | 32 | 32 | 32 | 32 |
| 1982 | 33 | 33 | 33 | 33 | 33 |
| 1983 | 34 | 34 | 34 | 34 | 34 |
| 1984 | 35 | 35 | 35 | 35 | 35 |
| 1985 | 36 | 36 | 36 | 36 | 36 |
| 1986 | 37 | 37 | 37 | 37 | 37 |
| 1987 | 38 | 38 | 38 | 38 | 38 |
| 1988 | 39 | 39 | 39 | 39 | 39 |
| 1989 | 40 | 40 | 40 | 40 | 40 |
| 1990 | 41 | 41 | 41 | 41 | 41 |
| 1991 | 42 | 42 | 42 | 42 | 42 |
| 1992 | 43 | 43 | 43 | 43 | 43 |
| 1993 | 44 | 44 | 44 | 44 | 44 |
| 1994 | 45 | 45 | 45 | 45 | 45 |
| 1995 | 46 | 46 | 46 | 46 | 46 |
| 1996 | 47 | 47 | 47 | 47 | 47 |
| 1997 | 48 | 48 | 48 | 48 | 48 |
| 1998 | 49 | 49 | 49 | 49 | 49 |
| 1999 | 50 | 50 | 50 | 50 | 50 |
| 2000 | 51 | 51 | 51 | 51 | 51 |
| 2001 | 52 | 52 | 52 | 52 | 52 |
| 2002 | 53 | 53 | 53 | 53 | 53 |
| 2003 | 54 | 54 | 54 | 54 | 54 |
| 2004 | 55 | 55 | 55 | 55 | 55 |
| 2005 | 56 | 56 | 56 | 56 | 56 |
| 2006 | 57 | 57 | 57 | 57 | 57 |
| 2007 | 58 | 58 | 58 | 58 | 58 |
| 2008 | 59 | 59 | 59 | 59 | 59 |
| 2009 | 60 | 60 | 60 | 60 | 60 |
| 2010 | 61 | 61 | 61 | 61 | 61 |
| 2011 | 62 | 62 | 62 | 62 | 62 |
| 2012 | 63 | 63 | 63 | 63 | 63 |
| 2013 | 64 | 64 | 64 | 64 | 64 |
| 2014 | 65 | 65 | 65 | 65 | 65 |
| 2015 | 66 | 66 | 66 | 66 | 66 |
| 2016 | 67 | 67 | 67 | 67 | 67 |
| 2017 | 68 | 68 | 68 | 68 | 68 |
| 2018 | 69 | 69 | 69 | 69 | 69 |
| 2019 | 70 | 70 | 70 | 70 | 70 |
| 2020 | 71 | 71 | 71 | 71 | 71 |
| 2021 | 72 | 72 | 72 | 72 | 72 |
| 2022 | 73 | 73 | 73 | 73 | 73 |
| 2023 | 74 | 74 | 74 | 74 | 74 |
| 2024 | 75 | 75 | 75 | 75 | 75 |
| 2025 | 76 | 76 | 76 | 76 | 76 |
| 2026 | 77 | 77 | 77 | 77 | 77 |
| 2027 | 78 | 78 | 78 | 78 | 78 |
| 2028 | 79 | 79 | 79 | 79 | 79 |
| 2029 | 80 | 80 | 80 | 80 | 80 |
| 2030 | 81 | 81 | 81 | 81 | 81 |
| 2031 | 82 | 82 | 82 | 82 | 82 |
| 2032 | 83 | 83 | 83 | 83 | 83 |
| 2033 | 84 | 84 | 84 | 84 | 84 |
| 2034 | 85 | 85 | 85 | 85 | 85 |
| 2035 | 86 | 86 | 86 | 86 | 86 |
| 2036 | 87 | 87 | 87 | 87 | 87 |
| 2037 | 88 | 88 | 88 | 88 | 88 |
| 2038 | 89 | 89 | 89 | 89 | 89 |
| 2039 | 90 | 90 | 90 | 90 | 90 |
| 2040 | 91 | 91 | 91 | 91 | 91 |
| 2041 | 92 | 92 | 92 | 92 | 92 |
| 2042 | 93 | 93 | 93 | 93 | 93 |
| 2043 | 94 | 94 | 94 | 94 | 94 |
| 2044 | 95 | 95 | 95 | 95 | 95 |
| 2045 | 96 | 96 | 96 | 96 | 96 |
| 2046 | 97 | 97 | 97 | 97 | 97 |
| 2047 | 98 | 98 | 98 | 98 | 98 |
| 2048 | 99 | 99 | 99 | 99 | 99 |
| 2049 | 100 | 100 | 100 | 100 | 100 |

| TABLE I | | | TABLE II | | |
|---------|------|------|----------|------|------|
| Year | 1950 | 1951 | Year | 1952 | 1953 |
| 1950 | 1 | 2 | 1950 | 1 | 2 |
| 1951 | 1 | 3 | 1951 | 1 | 3 |
| 1952 | 1 | 4 | 1952 | 1 | 4 |
| 1953 | 1 | 5 | 1953 | 1 | 5 |
| 1954 | 1 | 6 | 1954 | 1 | 6 |
| 1955 | 1 | 7 | 1955 | 1 | 7 |
| 1956 | 1 | 8 | 1956 | 1 | 8 |
| 1957 | 1 | 9 | 1957 | 1 | 9 |
| 1958 | 1 | 10 | 1958 | 1 | 10 |
| 1959 | 1 | 11 | 1959 | 1 | 11 |
| 1960 | 1 | 12 | 1960 | 1 | 12 |
| 1961 | 1 | 13 | 1961 | 1 | 13 |
| 1962 | 1 | 14 | 1962 | 1 | 14 |
| 1963 | 1 | 15 | 1963 | 1 | 15 |
| 1964 | 1 | 16 | 1964 | 1 | 16 |
| 1965 | 1 | 17 | 1965 | 1 | 17 |
| 1966 | 1 | 18 | 1966 | 1 | 18 |
| 1967 | 1 | 19 | 1967 | 1 | 19 |
| 1968 | 1 | 20 | 1968 | 1 | 20 |
| 1969 | 1 | 21 | 1969 | 1 | 21 |
| 1970 | 1 | 22 | 1970 | 1 | 22 |
| 1971 | 1 | 23 | 1971 | 1 | 23 |
| 1972 | 1 | 24 | 1972 | 1 | 24 |
| 1973 | 1 | 25 | 1973 | 1 | 25 |
| 1974 | 1 | 26 | 1974 | 1 | 26 |
| 1975 | 1 | 27 | 1975 | 1 | 27 |
| 1976 | 1 | 28 | 1976 | 1 | 28 |
| 1977 | 1 | 29 | 1977 | 1 | 29 |
| 1978 | 1 | 30 | 1978 | 1 | 30 |
| 1979 | 1 | 31 | 1979 | 1 | 31 |
| 1980 | 1 | 32 | 1980 | 1 | 32 |
| 1981 | 1 | 33 | 1981 | 1 | 33 |
| 1982 | 1 | 34 | 1982 | 1 | 34 |
| 1983 | 1 | 35 | 1983 | 1 | 35 |
| 1984 | 1 | 36 | 1984 | 1 | 36 |
| 1985 | 1 | 37 | 1985 | 1 | 37 |
| 1986 | 1 | 38 | 1986 | 1 | 38 |
| 1987 | 1 | 39 | 1987 | 1 | 39 |
| 1988 | 1 | 40 | 1988 | 1 | 40 |
| 1989 | 1 | 41 | 1989 | 1 | 41 |
| 1990 | 1 | 42 | 1990 | 1 | 42 |
| 1991 | 1 | 43 | 1991 | 1 | 43 |
| 1992 | 1 | 44 | 1992 | 1 | 44 |
| 1993 | 1 | 45 | 1993 | 1 | 45 |
| 1994 | 1 | 46 | 1994 | 1 | 46 |
| 1995 | 1 | 47 | 1995 | 1 | 47 |
| 1996 | 1 | 48 | 1996 | 1 | 48 |
| 1997 | 1 | 49 | 1997 | 1 | 49 |
| 1998 | 1 | 50 | 1998 | 1 | 50 |
| 1999 | 1 | 51 | 1999 | 1 | 51 |
| 2000 | 1 | 52 | 2000 | 1 | 52 |
| 2001 | 1 | 53 | 2001 | 1 | 53 |
| 2002 | 1 | 54 | 2002 | 1 | 54 |
| 2003 | 1 | 55 | 2003 | 1 | 55 |
| 2004 | 1 | 56 | 2004 | 1 | 56 |
| 2005 | 1 | 57 | 2005 | 1 | 57 |
| 2006 | 1 | 58 | 2006 | 1 | 58 |
| 2007 | 1 | 59 | 2007 | 1 | 59 |
| 2008 | 1 | 60 | 2008 | 1 | 60 |
| 2009 | 1 | 61 | 2009 | 1 | 61 |
| 2010 | 1 | 62 | 2010 | 1 | 62 |
| 2011 | 1 | 63 | 2011 | 1 | 63 |
| 2012 | 1 | 64 | 2012 | 1 | 64 |
| 2013 | 1 | 65 | 2013 | 1 | 65 |
| 2014 | 1 | 66 | 2014 | 1 | 66 |
| 2015 | 1 | 67 | 2015 | 1 | 67 |
| 2016 | 1 | 68 | 2016 | 1 | 68 |
| 2017 | 1 | 69 | 2017 | 1 | 69 |
| 2018 | 1 | 70 | 2018 | 1 | 70 |
| 2019 | 1 | 71 | 2019 | 1 | 71 |
| 2020 | 1 | 72 | 2020 | 1 | 72 |
| 2021 | 1 | 73 | 2021 | 1 | 73 |
| 2022 | 1 | 74 | 2022 | 1 | 74 |
| 2023 | 1 | 75 | 2023 | 1 | 75 |
| 2024 | 1 | 76 | 2024 | 1 | 76 |
| 2025 | 1 | 77 | 2025 | 1 | 77 |
| 2026 | 1 | 78 | 2026 | 1 | 78 |
| 2027 | 1 | 79 | 2027 | 1 | 79 |
| 2028 | 1 | 80 | 2028 | 1 | 80 |
| 2029 | 1 | 81 | 2029 | 1 | 81 |
| 2030 | 1 | 82 | 2030 | 1 | 82 |
| 2031 | 1 | 83 | 2031 | 1 | 83 |
| 2032 | 1 | 84 | 2032 | 1 | 84 |
| 2033 | 1 | 85 | 2033 | 1 | 85 |
| 2034 | 1 | 86 | 2034 | 1 | 86 |
| 2035 | 1 | 87 | 2035 | 1 | 87 |
| 2036 | 1 | 88 | 2036 | 1 | 88 |
| 2037 | 1 | 89 | 2037 | 1 | 89 |
| 2038 | 1 | 90 | 2038 | 1 | 90 |
| 2039 | 1 | 91 | 2039 | 1 | 91 |
| 2040 | 1 | 92 | 2040 | 1 | 92 |
| 2041 | 1 | 93 | 2041 | 1 | 93 |
| 2042 | 1 | 94 | 2042 | 1 | 94 |
| 2043 | 1 | 95 | 2043 | 1 | 95 |
| 2044 | 1 | 96 | 2044 | 1 | 96 |
| 2045 | 1 | 97 | 2045 | 1 | 97 |
| 2046 | 1 | 98 | 2046 | 1 | 98 |
| 2047 | 1 | 99 | 2047 | 1 | 99 |
| 2048 | 1 | 100 | 2048 | 1 | 100 |

Manganese.

| Wave-lengths | Intensities | | Wave-lengths | Intensities. | |
|--------------|-------------|-------|--------------|--------------|-------|
| | Arc | Spark | | Arc | Spark |
| 2812.845 | 3 | 3 | 2892.406 | 2 | 4 |
| 13.488 | 3 | 1 | 92.672 | 2 | 1 |
| 13.997 | 2 | 1 | 97.810 | 2 | |
| 14.935 | 2 | 3 | 98.006 | 2 | |
| 15.618 | 2 | 1 | 2900.563 | 1 | 4 |
| 17.198 | 2 | 1 | 2.212 | 2 | |
| 17.986 | 3 | 1 | 7.236 | 3 | 1 |
| 18.710 | 3 | | 8.004 | 1 | 1 |
| 18.844 | 1 | | 8.866 | 1 | 1 |
| 21.571 | 2 | 1 | 14.615 | 2 | 2 |
| 22.561 | 3 | 1 | 20.480 | 1 | 1 |
| 28.806 | 2 | 1 | 23.728 | 1 | 1 |
| 30.807 | 3 | 2 | 24.450 | 1 | 1 |
| 36.328 | 2 | 1 | 25.597 | 6 | 2 |
| 53.670 | 2 | | 28.699 | 3 | 1 |
| 72.554 | 2 | 1 | 30.153 | 2 | |
| 74.980 | 1 | 4 | 33.068 | 7 | 6 |
| 82.516 | 1 | 1 | 34.034 | 3 | 1 |
| 86.688 | 1 | 4 | 35.663 | 2 | 1 |
| 89.550 | 2 | 6 | 37.314 | 7 | 6 |
| 89.622 | 1 | 3 | 40.350 | 2 | 1 |

Manganese.

| Wavelengths | Intensities | | Wavelengths | Intensities. | |
|-------------|-------------|-------|-------------|--------------|--------|
| | Arc | Spark | | Arc | Spark. |
| 2940.512 | 0 | 1 | 3045.589 | 3 | 2 |
| 41.047 | 3 | 1 | 45.615 | 2 | 1 |
| 41.684 | 1 | 1 | 47.040 | 3 | 2 |
| 41.755 | 1 | 1 | 54.369 | 0 | 2 |
| 44.410 | 1 | 1 | 62.131 | 5 | 2 |
| 49.224 | 8 | 9 | 64.034 | 1 | 1 |
| 53.031 | 1 | 1 | 70.306 | 5 | 2 |
| 63.615 | 2 | 1 | 73.149 | 1 | 2 |
| 72.582 | 2 | 1 | 79.612 | 1 | 2 |
| 3002.492 | 1 | 1 | 81.331 | 4 | 2 |
| 7.657 | 2 | 1 | 97.052 | 4 | 2 |
| 11.171 | 2 | 1 | 110.086 | 3 | 2 |
| 11.378 | 2 | 1 | 13.037 | 1 | 1 |
| 16.462 | 3 | 1 | 13.608 | 2 | 1 |
| 22.754 | 3 | 1 | 15.475 | 3 | 2 |
| 40.601 | 3 | 2 | 20.342 | 2 | 1 |
| 41.251 | 2 | 1 | 22.866 | 1 | 1 |
| 43.146 | 2 | 2 | 25.023 | 1 | 1 |
| 43.348 | 3 | 2 | 26.636 | 1 | 1 |
| 43.773 | 3 | 1 | 32.296 | 2 | 1 |
| 44.592 | 0 | 3 | 32.503 | 2 | 1 |

Manganese.

| Wavelengths | Intensities | | Wavelengths | Intensities. | |
|-------------|-------------|-------|-------------|--------------|--------|
| | Arc | Spark | | Arc | Spark. |
| 3136.960 | 2 | 1 | 5236.762 | 6 | 0 |
| 42.674 | 3 | 1 | 57.572 | 0 | 2 |
| 48.188 | 5 | 2 | 40.373 | 4 | 2 |
| 58.751 | 1 | 1 | 40.604 | 4 | 2 |
| 59.346 | 2 | 1 | 43.778 | 5 | 4 |
| 61.053 | 5 | 2 | 46.508 | 4 | 4 |
| 77.053 | 1 | 1 | 51.117 | 4 | 3 |
| 78.445 | 6 | 3 | 52.937 | 5 | 4 |
| 89.957 | 1 | 1 | 56.140 | 5 | 5 |
| 95.327 | 2 | 1 | 58.410 | 4 | 4 |
| 3201.121 | 2 | 1 | 60.212 | 4 | 3 |
| 2.539 | 2 | 1 | 64.692 | 4 | 4 |
| 3.736 | 2 | 1 | 67.794 | 3 | 5 |
| 6.894 | 3 | 1 | 68.703 | 3 | 2 |
| 12.862 | 5 | 3 | 70.347 | 3 | 2 |
| 16.928 | 3 | 2 | 73.010 | 3 | 2 |
| 23.225 | 2 | 1 | 78.544 | 3 | 2 |
| 24.745 | 4 | 2 | 80.640 | 1 | 1 |
| 26.015 | 3 | 2 | 80.744 | 5 | 1 |
| 28.071 | 7 | 5 | 90.979 | 2 | 1 |
| 30.700 | 5 | 4 | 95.836 | 2 | 1 |

Manganese.

| Wavelengths | Intensities | | Wavelengths | Intensities. | |
|-------------|-------------|-------|-------------|------------------|-------------------|
| | Arc | Spark | | Arc | Spark. |
| 3296.027 | 2 | 1 | 3354.652 | 1 | |
| 96.872 | 3 | 2 | 36.226 | 2 | 2 |
| 98.280 | 3 | 3 | 3407.982 | 1 | 1 |
| 3300.950 | 2 | | 19.801 | 1 | 1 |
| 3.277 | 3 | 2 | 33.570 | 3 | 2 |
| 4.898 | 2 | 2 | 38.978 | 3 | 3 |
| 7.008 | 3 | 2 | 41.998 | 5 | 10 n ^h |
| 8.765 | 3 | 1 | 50.614 | 2 | 2 |
| 11.906 | 3 | 2 | 60.630 | 5 n ^h | 10 n ^h |
| 13.199 | 3 | 2 | 74.064 | 4 | 5 |
| 13.514 | 3 | 2 | 74.136 | 4 | 5 |
| 14.419 | 2 | 1 | 82.924 | 4 | 10 n ^h |
| 14.898 | 3 | 2 | 88.676 | 4 | 10 n ^h |
| 16.326 | 3 | 2 | 95.645 | 5 | 5 |
| 16.452 | 1 | 1 | 97.526 | 3 | 8 |
| 17.304 | 4 | 2 | 3524.546 | | 5 |
| 20.693 | 4 | 2 | 31.839 | 4 | 5 |
| 30.666 | 4 | 1 | 32.002 | 5 | 5 |
| 43.729 | 3 | 2 | 32.128 | 5 | 5 |
| 45.354 | 3 | 1 | 47.790 | 5 | 10 |
| 51.665 | 2 | 1 | 46.025 | 4 | 5 |

Manganese.

| Wavelengths | Intensities | | Wavelengths | Intensities. | |
|-------------|-------------|-------|-------------|--------------|--------|
| | Arc | Spark | | Arc | Spark. |
| 3548.187 | 4 | 8 | 3669.839 | 1 | 1 |
| 52.737 | 2 | 1 | 70.518 | 3 | 1 |
| 69.485 | 5 | 8 | 76.950 | 3 | 2 |
| 69.796 | 8 | 8 | 80.147 | 1 | 1 |
| 70.061 | 4 | 6 | 82.091 | 2 | 2 |
| 74.085 | 1 | | 84.666 | 1 | 1 |
| 77.865 | 7 | 8 | 91.815 | 1 | |
| 79.656 | 2 | 1 | 93.668 | 4 | 4 |
| 80.120 | 1 | | 96.588 | 4 | 3 |
| 83.692 | 2 | 1 | 3700.302 | 1 | 1 |
| 86.536 | 5 | 5 | 1.733 | 3 | 2 |
| 89.980 | 1 | | 6.074 | 4 | 4 |
| 95.109 | 5 | 4 | 18.926 | 4 | 3 |
| 3601.279 | 1 | 1 | 31.925 | 3 | 3 |
| 7.530 | 6 | 6 | 40.613 | 3 | 2 |
| 8.532 | 6 | 6 | 50.758 | 2 | 1 |
| 10.298 | 6 | 6 | 56.631 | 2 | 1 |
| 19.407 | 6 | 5 | 63.376 | 2 | 2 |
| 23.794 | 5 | 4 | 67.686 | 2 | 1 |
| 29.740 | 4 | 3 | 68.261 | 3 | 1 |
| 60.405 | 3 | 3 | 98.262 | 2 | . |

Manganese.

| Wavelengths | Intensities | | Wavelengths | Intensities | |
|-------------|-------------|-------|-------------|-------------|-------|
| | Arc | Spark | | Arc | Spark |
| 3759.456 | 2 | 2 | 3853.427 | 3 | 3 |
| 3800.551 | 2 | 2 | 56.603 | 3 | 3 |
| 1.909 | 2 | 2 | 64.107 | 3 | 2 |
| 6.709 | 3 | 1 | 72.046 | 3 | 2 |
| 6.860 | 7 | 8 | 72.956 | 3 | 2 |
| 9.119 | 2 | 2 | 73.373 | 3 | 1 |
| 1.591 | 5 | 4 | 89.448 | 3 | 3 |
| 10.687 | 2 | 2 | 96.347 | 2 | 2 |
| 16.736 | 2 | 3 | 98.362 | 3 | 3 |
| 23.510 | 4 | 5 | 3904.316 | 1 | 2 |
| 23.882 | 4 | 4 | 4.960 | 2 | 1 |
| 24.712 | 3 | 2 | 11.120 | 3 | 1 |
| 32.435 | 3 | 2 | 12.424 | 2 | 2 |
| 33.836 | 5 | 5 | 16.628 | 2 | 1 |
| 34.361 | 6 | 6 | 18.312 | 3 | 2 |
| 36.508 | 4 | 1 | 21.766 | 3 | 1 |
| 38.329 | 4 | 2 | 22.682 | 3 | 1 |
| 39.776 | 4 | 4 | 23.337 | 2 | 2 |
| 41.711 | 4 | 5 | 24.010 | 3 | 2 |
| 43.979 | 3 | 4 | 25.470 | 4 | 1 |
| 52.403 | 3 | 2 | 25.752 | 3 | 2 |

Manganese.

| Wavelengths | Intensities | | Wavelengths | Intensities. | |
|-------------|-------------|-------|-------------|--------------|--------|
| | Arc | Spark | | Arc | Spark. |
| 3939.654 | 3 | 2 | 4011.534 | 2 | 1 |
| 39.757 | 2 | 2 | 18.093 | 6 | 6 |
| 42.974 | 2 | 1 | 20.063 | 3 | 1 |
| 52.844 | 2 | 2 | 26.226 | 3 | 2 |
| 75.882 | 2 | 2 | 28.601 | 2 | 1 |
| 77.081 | 2 | 2 | 31.797 | 18 nA | 7 |
| 80.151 | 1 | 1 | 33.057 | 18 n | 5 |
| 80.883 | 1 | 1 | 34.477 | 18 n | 5 |
| 82.170 | 1 | 1 | 35.724 | 5 | 5 |
| 86.572 | 2 | 2 | 37.856 | 3 | 1 |
| 87.908 | 1 | 1 | 41.343 | 12 | 6 |
| 84.177 | 2 | 1 | 45.208 | 4 | 3 |
| 85.558 | 3 | 2 | 48.734 | 11 | 5 |
| 87.097 | 3 | 2 | 49.012 | 2 | 2 |
| 87.489 | 3 | 2 | 49.445 | 3 | 1 |
| 89.677 | 1 | 1 | 51.126 | 2 | 1 |
| 91.602 | 1 | 1 | 52.461 | 2 | 2 |
| 92.435 | 2 | 1 | 53.205 | 2 | 2 |
| 4001.140 | 1 | 1 | 55.545 | 10 | 4 |
| 3.352 | 2 | 1 | 57.948 | 4 | 2 |
| .030 | 2 | 1 | 58.127 | 5 | 4 |

Man anese.

| Wavelengths | Intensities | | Wavelengths | Intensities. | |
|-------------|-------------|---------|-------------|--------------|---------|
| | Arm. | Sparks. | | Arm. | Sparks. |
| 6082.375 | 4 | 2 | 610.917 | 6 | 2 |
| 61.741 | 5 | 2 | 62.250 | 3 | 1 |
| 63.553 | 7 | 2 | 64.409 | 2 | 1 |
| 65.019 | 2 | 2 | 66.280 | 7 | 1 |
| 66.621 | 6 | 1 | 68.770 | 2 | 1 |
| 67.958 | 3 | 1 | 69.816 | 1 | 1 |
| 70.235 | 2 | 3 | 70.543 | 1 | 1 |
| 73.251 | 2 | 1 | 72.120 | 5 | 5 |
| 73.604 | 7 | 1 | 74.550 | 1 | 1 |
| 75.170 | 7 | 1 | 76.618 | 2 | 1 |
| 80.927 | 2 | 1 | 85.033 | 4 | 2 |
| 83.320 | 1 | 1 | 87.775 | 2 | 1 |
| 88.932 | 3 | 1 | 92.060 | 3 | 2 |
| 91.343 | 2 | 1 | 95.530 | 3 | 1 |
| 95.310 | 1 | 1 | 97.794 | 3 | 2 |
| 98.245 | 2 | 1 | 55.448 | 6 | 1 |
| 4102.670 | 2 | 1 | 57.003 | 3 | 1 |
| 3.470 | 1 | 1 | 70.594 | 4 | 3 |
| 3.810 | 3 | 1 | 80.952 | 3 | 2 |
| 5.370 | 3 | 1 | 4801.720 | 1 | 1 |
| 7.210 | 2 | 1 | 11.750 | 2 | 2 |

Manganese.

| Wavelengths | Intensities | | Wavelengths | Intensities. | |
|-------------|-------------|-------|-------------|--------------|--------|
| | Arc | Spark | | Arc | Spark. |
| 4280.613 | 3 | 1 | 4281.251 | 3 | 4 |
| 43.125 | 1 | 4 | 47.110 | 1 | 1 |
| 33.703 | | 1 | 52.584 | 0 | 1 |
| 3.723 | 6 | 3 | 52.535 | 0 | 1 |
| 37.313 | 5 | 3 | 53.015 | 4 | 3 |
| 61.299 | 3 | 1 | 55.012 | 5 | 3 |
| 65.920 | 5 | 3 | 55.920 | 5 | 3 |
| 72.182 | 2 | 1 | 55.820 | 5 | 0 |
| 31.027 | 5 | 3 | 5.051 | 7 | 3 |
| 54.084 | 5 | 2 | 5.735 | 5 | 4 |
| 4300.203 | 2 | 1 | 57.215 | 5 | 4 |
| 12.54 | 4 | 1 | 60.389 | 4 | 2 |
| 23.402 | 1 | 1 | 61.090 | 0 | 4 |
| 74.030 | 3 | 0 | 62.037 | 7 | 1 |
| 31.701 | 3 | 2 | 64.160 | 1 | 1 |
| 66.339 | 2 | 1 | 70.128 | 0 | 4 |
| 4406.084 | 2 | 1 | 72.200 | 0 | 4 |
| 11.875 | 3 | 2 | 72.100 | 2 | 2 |
| 14.280 | 6 | 4 | 90.671 | 5 | 3 |
| 15.774 | 3 | 2 | 91.145 | 3 | 2 |
| 36.051 | 0 | 1 | 91.547 | 3 | 1 |

Man. resp.

| Wavelengths | Intensities | | Wavelengths | Intensities | |
|-------------|-------------|-------|-------------|-------------|-------|
| | Arc | Spark | | Arc | Spark |
| 4498.898 | 5 | 5 | 4925.400 | 2 | 1 |
| 4502.218 | 6 | 5 | 46.901 | 2 | 1 |
| 46.810 | 3 | 2 | 39.840 | 2 | 1 |
| 23.407 | 2 | 1 | 44.312 | 3 | 1 |
| 40.451 | 3 | 1 | 54.613 | 1 | 1 |
| 44.427 | 2 | 1 | 54.805 | 1 | 1 |
| 48.589 | 3 | 1 | 62.052 | 1 | |
| 4605.378 | 5 | 3 | 4935.976 | 3 | 1 |
| 26.552 | 5 | 3 | 74.349 | 1 | |
| 71.694 | 4 | 1 | 85.777 | 2 | 1 |
| 4701.110 | 3 | 1 | 5004.910 | 3 | 1 |
| 6.703 | 7 | 4 | 10.330 | 2 | 1 |
| 27.476 | 7 | 4 | 29.818 | 1 | 1 |
| 39.004 | 6 | 3 | 30.643 | 1 | 1 |
| 54.046 | 10 n | 6 | 74.406 | 2 | 1 |
| 21.521 | 6 | 4 | 86.715 | 1 | |
| 62.375 | 8 | | 5117.944 | 3 | |
| 35.852 | 6 | 4 | 49.255 | 1 | |
| 66.414 | 5 | 4 | 50.937 | 2 | 1 |
| 83.451 | 10 n | 6 | 97.203 | 5 | 3 |
| 4823.521 | 10 n | 6 | 97.026 | 2 | |

Manganese.

| Wavelengths | Intensities | | Wavelengths | Intensities. | |
|-------------|-------------|-------|-------------|--------------|--------|
| | Arc | Spark | | Arc | Spark. |
| 5255.330 | 6 | 3 | 5750.168 | 6 | 2 |
| 50.774 | 3 | 1 | 5826.837 | 5 | 2 |
| 98.033 | 2 | 1 | 48.951 | 4 | 2 |
| 5341.068 | 8 | 5 | 6013.480 | 10 | 10 |
| 77.623 | 7 | 4 | 16.631 | 10 | 10 |
| 83.526 | 6 | 4 | 21.794 | 10 | 10 |
| 94.679 | 7 | 3 | | | |
| 19.494 | 6 | 4 | | | |
| 5407.429 | 6 | 3 | | | |
| 13.690 | 4 | 2 | | | |
| 20.371 | 6 | 6 | | | |
| 32.553 | 4 | 2 | | | |
| 70.644 | 7 | 4 | | | |
| 81.401 | 6 | 2 | | | |
| 5505.874 | 3 | 5 | | | |
| 16.774 | 6 | 4 | | | |
| 37.753 | 4 | 3 | | | |
| 51.991 | 3 | 3 | | | |
| 73.016 | 1 | 2 | | | |
| 73.688 | 2 | 2 | | | |
| 5738.287 | 6 | 2 | | | |

Vanadium.

| Wavelengths | Intensities | | Wavelengths | Intensities | |
|-------------|-------------|-------|-------------|-------------|--------|
| | Arc | Spark | | Arc | Spark. |
| 3128.224 | 2 | | 3210.674 | 5 | |
| 30.261 | 4 | | 32.917 | 4 | |
| 32.332 | 1 | | 34.503 | 3 | |
| 34.944 | 4 | | 36.098 | 10 | |
| 36.527 | 3 | | 3700.005 | 4 | |
| 41.500 | 2 | | 4.227 | 2 | |
| 42.423 | 4 | | 4.376 | 10 | |
| 45.354 | 4 | | 4.459 | 3 | |
| 45.979 | 2 | | 5.266 | 3 | |
| 47.275 | 2 | | 5.575 | 6 | |
| 55.405 | 2 | | 7.404 | 7 | |
| 62.568 | 2 | | 8.351 | 4 | |
| 64.740 | 3 | | 10.104 | 3 | |
| 68.136 | 3 | | 10.433 | 2 | |
| 73.407 | 15 | | 12.396 | 7 | |
| 83.984 | 15 | | 14.731 | 4 | |
| 85.402 | 15 | | 15.380 | 3 | |
| 87.700 | 7 | | 17.119 | 4 | |
| 88.079 | 2 | | 18.872 | 2 | |
| 88.503 | 5 | | 26.109 | 3 | |
| 89.078 | 2 | | 27.125 | 2 | |

Vanadium.

| Wavelengths | Intensity | Wavelengths | Intensity |
|-------------|----------------------|-------------|-----------------------|
| Å. | S ₁ spark | Å. | S ₂ spark. |
| 3227.413 | 3 | 3201.066 | 3 |
| 33.612 | 3 | 32.075 | 3 |
| 30.347 | 3 | 33.030 | 7 |
| 31.952 | 3 | 35.404 | 1 |
| 33.191 | 3 | 36.010 | 3 |
| 34.550 | 2 | 37.690 | 13 |
| 35.866 | 2 | 71.129 | 12 |
| 37.519 | 3 | 71.636 | 2 |
| 38.550 | 3 | 73.023 | 3 |
| 37.879 | 3 | 76.130 | 13 |
| 39.045 | 3 | | |
| 41.177 | 3 | 77.946 | 3 |
| 41.930 | 3 | 79.145 | 4 |
| 43.287 | 2 | 82.533 | 3 |
| 49.574 | 3 | 83.310 | 1 |
| 50.776 | 3 | 84.364 | 1 |
| 51.609 | 3 | 84.566 | 3 |
| 52.511 | 3 | 81.680 | 3 |
| 54.766 | 2 | 88.146 | 1 |
| 55.653 | 3 | 88.736 | 1 |
| 56.542 | 3 | 89.066 | 3 |
| | | 8800.136 | 2 |

Vanadium.

| Wavelengths. | Intensities. Arc Spark | Wavelengths | Intensities. Arc Spark |
|--------------|---------------------------|-------------|---------------------------|
| 3301.134 | 4 | 3365.949 | 3 |
| 19.024 | 3 | 37.510 | 2 |
| 20.147 | 3 | 39.368 | 3 |
| 21.551 | 3 | 39.773 | 3 |
| 21.692 | 3 | 39.828 | 2 |
| 24.391 | 3 | 37.385 | 3 |
| 27.136 | 2 | 37.845 | 3 |
| 28.407 | 2 | 3400.401 | 3 |
| 29.338 | 3 | 1.349 | 3 |
| 33.573 | 2 | 2.572 | 3 |
| 36.333 | 3 | 3.303 | 3 |
| 39.333 | 3 | 4.970 | 2 |
| 39.333 | 3 | 5.160 | 4 |
| 50.897 | 3 | 6.351 | 4 |
| 71.126 | 3 | 8.010 | 3 |
| 74.046 | 2 | 9.101 | 3 |
| 76.066 | 4 | 14.203 | 3 |
| 77.393 | 4 | 17.070 | 3 |
| 77.637 | 4 | 18.334 | 2 |
| 80.736 | 2 | 23.374 | 3 |
| 84.803 | 3 | 25.075 | 4 |

Vanadium.

| Wavelengths | Intensities | | Wavelengths | Intensities | |
|-------------|-------------|-------|-------------|-------------|-------|
| | Arc | Spark | | Arc | Spark |
| 3442.017 | 3 | | 3512.024 | 2 | |
| 40.330 | 3 | | 17.289 | 6 | |
| 43.819 | 3 | | 19.165 | 3 | |
| 54.100 | 3 | | 20.022 | 4 | |
| 56.530 | 3 | | 22.565 | 3 | |
| 57.157 | 3 | | 24.714 | 4 | |
| 63.415 | 2 | | 25.767 | 3 | |
| 71.843 | 3 | | 28.205 | 2 | |
| 82.188 | 2 | | 29.729 | 4 | |
| 85.531 | 3 | | 30.725 | 3 | |
| 89.477 | 4 | | 33.606 | 2 | |
| 93.165 | 4 | | 33.743 | 6 | |
| 96.942 | 4 | | 34.739 | 2 | |
| 97.058 | 3 | | 36.136 | 3 | |
| 98.203 | 2 | | 40.533 | 2 | |
| 99.337 | 2 | | 42.657 | 2 | |
| 3500.825 | 2 | | 43.495 | 4 | |
| 3.199 | 2 | | 45.186 | 4 | |
| 4.425 | 5 | | 45.343 | 4 | |
| 5.627 | 4 | | 45.922 | 2 | |
| 6.847 | 3 | | 51.506 | 2 | |

Vacuum.

| Wave-lengths | Intensity Arc Spark | Wave-lengths | Intensity Arc Spark |
|--------------|------------------------|--------------|------------------------|
| 5553.253 | 4 | 5592.534 | 2 |
| 56.147 | 1 | 56.552 | 3 |
| 56.759 | 2 | 5600.040 | 2 |
| 56.241 | 3 | 5.555 | 1 |
| 56.600 | 3 | 16.740 | 1 |
| 57.165 | 2 | 55.482 | 2 |
| 60.576 | 3 | 59.045 | 1 |
| 62.136 | 2 | 41.105 | 1 |
| 63.555 | 2 | 43.551 | 1 |
| 66.275 | 4 | 44.756 | 2 |
| 68.939 | 3 | 45.625 | 1 |
| 71.042 | 3 | 47.559 | 1 |
| 71.657 | 3 | 48.713 | 2 |
| 73.518 | 3 | 52.453 | 1 |
| 74.776 | 2 | 55.725 | 2 |
| 75.135 | 2 | 55.579 | 3 |
| 77.877 | 2 | 55.151 | 2 |
| 80.826 | 2 | 57.737 | 3 |
| 83.702 | 2 | 71.210 | 3 |
| 89.755 | 3 | 72.414 | 2 |
| 92.014 | 3 | 73.411 | 3 |

Va. Mub. 1.

| Wavelengths | Intensities Arc Spark | Wavelengths | Intensities Arc Spark |
|-------------|--------------------------|-------------|--------------------------|
| 5675.705 | 2 | 5715.467 | 3 |
| 76.655 | 5 | 19.017 | 1 |
| 10.115 | 2 | 12.004 | 1 |
| 81.287 | 1 | 22.201 | 1 |
| 65.123 | 4 | 27.350 | 2 |
| 66.163 | 3 | 29.047 | 1 |
| 86.703 | 1 | 32.756 | 2 |
| 88.073 | 5 | 34.426 | 2 |
| 90.277 | 5 | 37.999 | 1 |
| 92.225 | 5 | 38.752 | 2 |
| 94.527 | 1 | 41.513 | 2 |
| 95.347 | 4 | 45.807 | 2 |
| 95.866 | 5 | 47.156 | 1 |
| 96.027 | 1 | 47.992 | 2 |
| 97.434 | 1 | 50.675 | 2 |
| 5705.565 | 7 | 51.763 | 2 |
| 4.703 | 5 | 52.866 | 2 |
| 5.044 | 5 | 53.256 | 2 |
| 5.530 | 1 | 54.714 | 1 |
| 5.045 | 1 | 56.043 | 1 |
| 5.725 | 2 | 56.855 | 1 |

Vanadium.

| Wavelengths | Intensities Arc Spark | Wavelengths | Intensities Arc Spark. |
|-------------|--------------------------|-------------|---------------------------|
| 3759.519 | 2 | 3799.900 | 4 |
| 60.803 | 1 | 3803.474 | 5 |
| 61.444 | 1 | 3.786 | 2 |
| 65.143 | 2 | 3.914 | 2 |
| 69.079 | 2 | 6.605 | 1 |
| 70.841 | 1 | 7.507 | 2 |
| 72.154 | 1 | 8.525 | 4 |
| 74.111 | 1 | 9.609 | 5 |
| 75.720 | 1 | 13.494 | 5 |
| 76.160 | 1 | 15.555 | 3 |
| 78.680 | 4 | 17.854 | 1 |
| 79.650 | 1 | 18.245 | 4 |
| 81.409 | 2 | 19.973 | 4 |
| 82.553 | 1 | 21.490 | 5 |
| 84.671 | 1 | 22.014 | 2 |
| 87.553 | 2 | 22.902 | 5 |
| 90.326 | 5 | 23.225 | 3 |
| 90.484 | 2 | 23.985 | 2 |
| 93.619 | 2 | 25.195 | 2 |
| 94.655 | 1 | 25.572 | 2 |
| 95.473 | 1 | 25.627 | 2 |

Vanadium.

| Wavelengths | Intensities | | Wavelengths | Intensities | |
|-------------|-------------|-------|-------------|-------------|-------|
| | Arc | Spark | | Arc | Spark |
| 3331.041 | 2 | | 3855.367 | 2 | |
| 32.433 | 2 | | 50.834 | 7 | |
| 35.815 | 2 | | 50.870 | 2 | |
| 35.183 | 2 | | 58.691 | 2 | |
| 36.065 | 2 | | 59.926 | 2 | |
| 36.524 | 3 | | 60.637 | 2 | |
| 37.630 | 1 | | 62.227 | 2 | |
| 37.856 | 2 | | 62.497 | 1 | |
| 38.938 | 2 | | 63.314 | 1 | |
| 39.586 | 1 | | 63.677 | 1 | |
| 40.146 | 1 | | 64.857 | 4 | |
| 40.436 | 3 | | 67.642 | 3 | |
| 40.751 | 1 | | 71.091 | 2 | |
| 41.901 | 2 | | 72.747 | 1 | |
| 43.001 | 2 | | 75.897 | 5 | |
| 43.496 | 1 | | 76.096 | 4 | |
| 44.446 | 2 | | 85.785 | 1 | |
| 44.896 | 2 | | 86.590 | 2 | |
| 45.018 | 2 | | 90.136 | 5 | |
| 45.451 | 2 | | 91.651 | 3 | |
| 52.408 | 2 | | 94.049 | 2 | |

Vanadium.

| Wavelengths | Intensities | | Wavelengths | Intensities. | |
|-------------|-------------|-------|-------------|--------------|--------|
| | Arc | Spark | | Arc | Spark. |
| 3896.159 | 2 | | 3.27.932 | 3 | |
| 97.091 | 2 | | 30.020 | 4 | |
| 98.281 | 2 | | 31.347 | 3 | |
| 99.139 | 1 | | 34.026 | 3 | |
| 3.00.160 | 2 | | 35.143 | 2 | |
| 1.244 | 2 | | 36.288 | 2 | |
| 1.253 | 5 | | 38.216 | 2 | |
| 3.260 | 2 | | 39.337 | 2 | |
| 4.215 | 2 | | 42.008 | 3 | |
| 5.746 | 3 | | 43.888 | 3 | |
| 8.317 | 1 | | | | |
| 10.791 | 2 | | | | |
| 12.202 | 3 | | | | |
| 12.883 | 2 | | | | |
| 14.329 | 2 | | | | |
| 16.415 | 1 | | | | |
| 20.497 | 2 | | | | |
| 21.906 | 3 | | | | |
| 22.429 | 4 | | | | |
| 24.659 | 4 | | | | |
| 25.246 | 4 | | | | |

II. Effect of Capacity and Self-induction on the Wave-lengths of the Spark Lines.

In view of the work of Exner and Haschek¹, Haschek², Neuf³, Kuer⁴,
and Malenia⁵, Kayser⁶, Wladimir⁷, Cooper⁸ and others on spark
spectra, tests were made for the possible effect on the wave-lengths of
the spark lines in consequence of varying the capacity and self-induction
in the secondary circuit.

Apparatus and Methods.—The apparatus used was the same as that already
described, with the addition of self-induction in series in the spark
circuit. This self-induction was produced by three coils of No. 10
copper wire, each 1 meter long and having 100, 200, and 400 turns respec-
tively. The first and second were 3 cm. in diameter and the third 15 cm.
The second was mounted within the third and the whole was so arranged that
the self-induction could be varied within the limits, .000001 - .00012
henry, without stopping the spark.

-
1. Sitz. der Kais-Akad. der Wiss. in Wien 1897
 2. Astrophys. Journ. 14, 161, 1901
 3. " " 17, 236, 1903.
 4. " " 19, 251, 1904
 5. Handbuch der Spectroscopie 2, 11, 301-310.
 6. Astrophys. Journ. 21, 11, 1905
 7. " " 1909.

As several observers have announced detections of shift under varying conditions, it proved of interest to try it in the present case. In the beginning a test was made to see if any shift was produced by changing the one and the spurs in the same position. The one was set at its normal position, 10, and the other at 10 and 15 and 20, but no shift was detected relatively. All the recorded trials made, three were taken. Then the spurs were both were placed six or eight inches farther from the cliff than the one, which was displaced particularly to the side of the rating and the shift as far as the distance of the grating permitted, was observed. It was observed in place to place while the spurs were moving. No test gave the slightest evidence of a shift. In the last case a shift which was reflected in the definition of the image, which was observed as perfectly clear.

Table 1 - The possible situations: it is not necessary to be especially sensitive to ϵ and δ and ϵ and δ are not the same in exactly the

same possible, the procedure was that in all of the work.

The standard curve of plate exposure was subjected to variation of capacity at the limits of .0001 - .0012 ampere of self-induction at the limits .00001 - .0012 ampere. Special attention was given to those time from lines in the region near 13900 Å. The lines especially investigated for shift, but also were the spectra of the plates successively with the various combinations of capacity and self-induction, but also with variations of the width of the spectrum of the plate. In the latter case a shift of the sharp lines was observed caused blurring, which, however, was not observed. In order to detect mechanical shifts the ratio of half-time exposure was used.

General Effects.

The general effect of the increase of current from 10 amperes to 100 amperes was to intensify the lines of the spectrum and to shift the time of exposure. No reversals were found.

Self-induction also widened the air lines, lengthened the time of exposure, caused the exposure lines to revert to the blurred lines, and the characteristics of the spectra were changed. The effect of the increased lines to become asymmetrical and irregular, especially towards the blue end of the spectrum. The lines sharp and well defined, as observed under the same effect the self-induction was introduced.

Increase of capacity shortened the time of exposure, broadened the lines and made the enhanced lines asymmetrical and irregular, generally towards the red end of the spectrum. Large capacity caused a few lines to reverse.

Shift of Lines.

The titanium lines which, according to some observers, show a large displacement are lines that are either enhanced or are broad in the arc spectrum, and it is not seen to be the cause of the disagreement among investigators as to whether a true shift occurs. Kayser points out the difficulties of determining a true shift in regard to broad and asymmetrical lines. A true shift should mean a shift of the center of gravity, rather than the shift of the maximum point of intensity; but as there is at present no way of accurately determining the true center of gravity, owing to the variations of the area of the lines due to the time of exposure and of development, the center of maximum intensity is assumed to be the center of gravity.

So far as the writer has been able to discover, all calculations of shifts have been based on the position of the maximum intensity, which was found to vary slightly under different conditions of capacity and self-induction in the case of broad lines. Two of the titanium

lines, A3904.77 and A3904.54, are read and are not tried; and, in turn, A3904.77 and A3904.54 are tried and are not read. All are subject to asymmetrical broadening under changes of capacity and self-induction. Accordingly, in the present work there arose the difficulty of determining not only the true center of gravity, but also the need for of maximum intensity of these lines.

The conclusion drawn from the evidence furnished by this investigation is that a definable shift between arc and spark lines, or between spark lines subjected to different circuit conditions has been found.

No thanks are due in Federal Area, under whose supervision the work was conducted, Mr. L. H. Jewell, for his advice and assistance, and Dr. Anderson and Mr. Huxford, for their suggestions.

